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Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

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3 1 **Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis**
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6 2 Running title: **Telehealth and Patient Satisfaction**
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1
2
3 **30 Abstract**
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5 *31 Background:* The use of Telehealth has increased recently, and it has become an essential
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8 *32* component and evolving tool to patient care. Early adopters attempt to use Telehealth to deliver
9
10
11 *33* high quality care. Patient satisfaction is a key indicator of how well the telemedicine met patient
12
13 *34* expectations. The passage of Patient Protection and Affordable Care Act (PPACA) in the U.S.
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15 *35* has placed patient satisfaction as a gatekeeper to reimbursement.
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17 *36 Objective:* The objective of this systematic review and narrative analysis is to explore the
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19
20 *37* association of Telehealth and patient satisfaction in regards to effectiveness and efficiency.
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22 *38 Methods:* We used Boolean expressions to create a complex search string. Variations of this
23
24
25 *39* string were used in both CINAHL and MEDLINE. The initial search of 1732 articles were
26
27 *40* filtered several times to, and remaining articles were reviewed by multiple researchers. Key
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29 *41* points summarized independently, then the authors debated the merits of each article to reach
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31 *42* consensus (n=32).
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33

34 *43 Results:* The studies chosen reported a mixture of factors of effectiveness and efficiency for
35
36 *44* Telehealth and patient satisfaction. The factors listed most often were improved outcomes, ease
37
38 *45* of use, decreased travel time, low cost, and improved communication.
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41 *46 Conclusion:* This study found a variety of factors with Telehealth and patient satisfaction. Future
42
43 *47* work should create an evaluation tool with high validity and reliability to associate direct effects
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45 *48* that Telehealth has on patient satisfaction.
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49
50 *50* Key words: patient satisfaction; Telehealth; telemedicine; quality; access; patient quality;
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52 *51* telecommunications; home Telehealth.
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53 Strengths and limitations of this study

54 Strengths

- 55 • Uses PRISMA standard
- 56 • Sample size >30 selected with MeSH key terms in established research databases
- 57 • Multiple reviewers met several times to control for selection bias and to increase inter-
58 rater reliability

59 Limitations

- 60 • Telehealth, in general, is a relatively new topic in medicine (since 1990s), which makes it
61 difficult to assess trends over time
- 62 • Publication bias is difficult to control for

64 Introduction

65 Rationale

66 The mental image of medical house calls is one of archaic practices in small towns and
67 otherwise rural communities, or something associated with concierge medicine. However,
68 Telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to
69 more technological-delivered services, making it possible to receive healthcare services from the
70 comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot
71 before one's appointment. This review examines Telehealth and any association it might have
72 with patient satisfaction.

73 This review uses the definition of Telehealth from the World Health Organization:

74 The delivery of health care services, where distance is a critical factor, by all health care
75 professionals using information and communication technologies, for the exchange of
76 valid information for diagnosis, treatment, and prevention of disease and injuries,

1
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3 77 research and evaluation, and for the continuing education of health care providers, in all
4
5 78 the interests of advancing the health of individuals and their communities.¹
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8 79 Following the WHO's example, we did not distinguish between Telehealth and telemedicine;
9
10 80 instead we used the term Telehealth to address both Telehealth and telemedicine.¹ This broad
11
12 81 definition of Telehealth encompasses several modes of delivery, such as videoconferencing,
13
14 82 mobile applications, and secure messaging. The WHO recognizes several branches of
15
16 83 Telemedicine: Teleradiology, Teledermatology, Telepathology, and Telepsychology.¹ With the
17
18 84 increase use of technology in healthcare, there has been a great emphasis on Telehealth because
19
20 85 it can extend the services of providers to remote locations and capitalize on the availability of
21
22 86 subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it
23
24 87 has the potential of making healthcare services more convenient for patients, especially those in
25
26 88 rural areas, those with small children (child care), and those with mobility restrictions.^{2,3}
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31 89 Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of
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33 90 the customer, it is a measure of quality that is published in the US through its Healthcare
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35 91 Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the
36
37 92 Center for Medicare and Medicaid through results of Hospital Consumer Assessment of
38
39 93 Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare
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41 94 delivery, Telehealth relies heavily on patient satisfaction because the patients are the only source
42
43 95 of information that can report how they were treated and if the treatment received met the
44
45 96 patients' expectations of care.^{4,5} If the patients are not happy with their healthcare services being
46
47 97 provided remotely, the service becomes redundant and expensive. With the increase in
48
49 98 prevalence of Telehealth, it is important to maintain the key quality indicator of patient
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51 99 satisfaction regardless of modality of delivery. The voice of the customer needs to be
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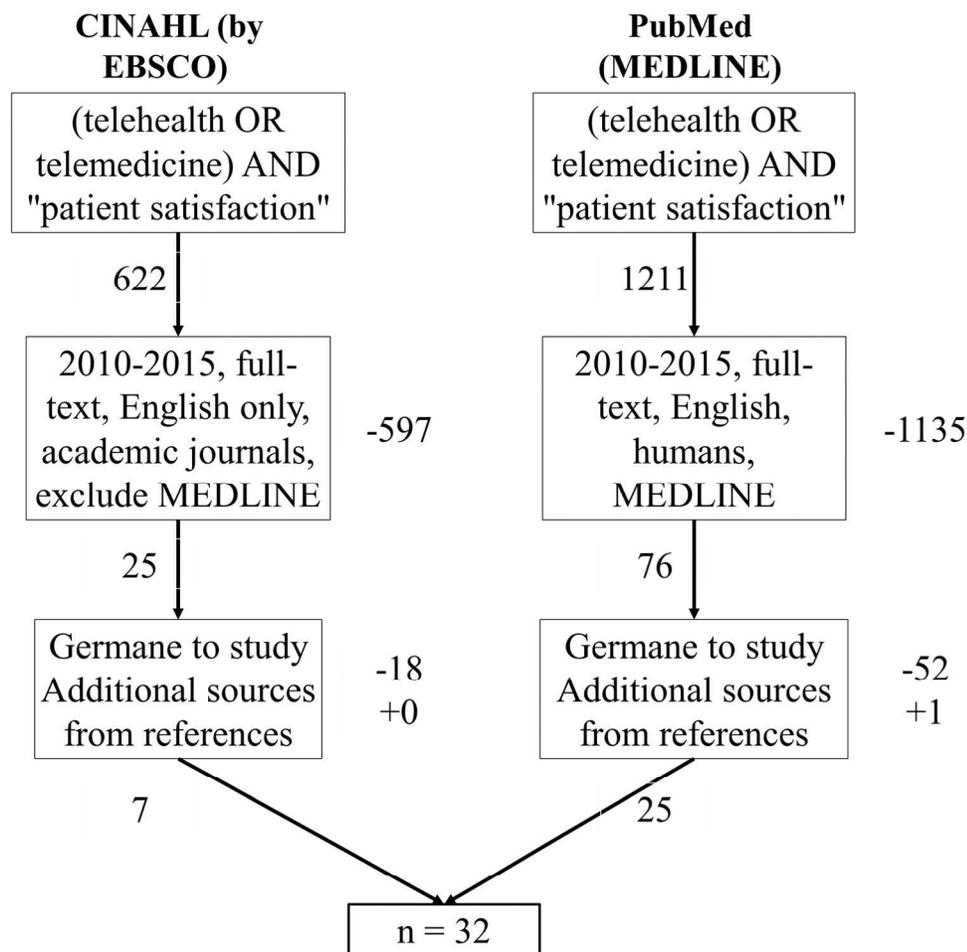
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3 100 continuously heard so that Telehealth developers can exercise agility in the development process
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5 101 while the healthcare organization continues to develop more technology-based care that meets
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8 102 the needs of patients and providers. The technology base inherent to Telehealth dramatically
9
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11 103 changes the mode of delivery, but a strong patient-to-provider relationship must be maintained
12
13 104 independent of the modality.

15 16 105 **Objective**

17 106 The purpose of this review is to evaluate the association of Telehealth with patient
18
19 107 satisfaction. To create the basic organization for this review, we looked to the Preferred
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21
22 108 Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which served as our
23
24 109 standard.⁶ Additional information for PRISMA can be found on their website.

27 110 **Methods**

28 111 Telehealth has rapidly changed and evolved over the past several years, which guided our
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31 112 research to reflect the current state of Telehealth and its relationship with patient satisfaction and
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34 113 indicators of effectiveness and efficiency. Our group wanted to identify an association of
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36 114 Telehealth with patient satisfaction. Six reviewers in our research group conducted some initial
37
38 115 homework on the concepts of Telehealth and patient satisfaction, and then we agreed on qualities
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40
41 116 and themes that we were looking for in articles. Due to CSK's background in the topic, he led
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43 117 these discussion sessions and coached the group through consensus meetings. This was done to
44
45 118 better ensure the group members understood what to look for in the abstracts and articles. A
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47
48 119 comprehensive search was performed as a group through the Cumulative Index of Nursing and
49
50 120 Allied Health Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE) using a variety of
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52 121 search terms from MeSH combined with Boolean operators. The initial searches included
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54
55 122 "Patient Satisfaction" AND "Telehealth" OR "Patient Satisfaction" AND "telemedicine". Figure
56
57 123 1 illustrates the in-depth article-selection process.

124 **Figure 1: Literature search process with inclusion and exclusion criteria**

125
126 Inclusion criteria were: 2010 through 2015, U.S. based, English only, full text available,
127 English, and human research. Publications that were relevant to both patient satisfaction and
128 Telehealth included journal articles, surveys, case and pilot studies, but other systematic reviews
129 were not analyzed as part of the study; instead, two reviews were earmarked for comparison in
130 the discussion section. Through this series of inclusion criteria, 1732 articles were eliminated and
131 101 articles passed onto the next step. To control for selection bias, multiple reviewers in the
132 group independently assessed the nature of the abstracts from the sample to determine whether it
133 was germane to our review. We agreed to include articles that included a combination of
134 Telehealth and patient satisfaction, and a measure of effectiveness or efficiency, but we would

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3 135 eliminate those that fell short of those goals. The reviewers met to discuss the merits of each
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5
6 136 abstract and eventually reached consensus ($Kappa=1.0$, excellent) on the final selection of 31
7
8 137 abstracts. The references of the remaining 31 were reviewed for articles that might have been
9
10
11 138 missed in the initial search. If multiple articles used a source that we did not already identify,
12
13 139 then it was added to the sample. This process identified one additional article (n=32). These
14
15 140 articles were then divided among reviewers to ensure that at least 2 reviewers read each article
16
17 141 and made independent observations. Reviewers compiled their notes on patient satisfaction,
18
19
20 142 effectiveness, and efficiency in a literature matrix and looked for implications. Another
21
22 143 consensus meeting was conducted to discuss findings and make inferences. During the consensus
23
24 144 meeting, observations were discussed and combined throughout the sample to assess possible
25
26
27 145 associations of Telehealth with patient satisfaction. This is a form of narrative analysis and
28
29 146 sensemaking.⁷ The observations of effectiveness and efficiency were combined into an affinity
30
31
32 147 matrix for additional analysis.

33 34 35 148 **Results**

36 37 149 **Study Selection, Study Characteristics and Results of Individual Studies**

38 150 The initial search with key words only resulted in 1833 results. We used several filters
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41 151 such as year published, which reduced the results to 101. Through a careful screening process,
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43 152 each abstract was reviewed by at least two reviewers. We all made independent
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45
46 153 recommendations on whether to include or not include. Then we met to discuss our
47
48 154 recommendations. Through this consensus meeting we reduced the sample to 32.

49
50 155 Table 1 lists a summary of our analysis and observations from our team (n=32). For every
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52 156 article/study in the sample, we made observations for *satisfied*, which was a screening criteria,
53
54
55 157 and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the
56
57 158 top. The reference numbers correspond to those in the references section.

159 **Table 1: Compilation of observations for our sample**

Author	Summary/Conclusion	Comments
Levy EL, et al. ⁸	<ul style="list-style-type: none"> • Satisfied (all but one participant reported satisfied or highly-satisfied) • Effective (participants demonstrated significant improvement in most outcomes measures) • Efficient (participants avoided 2,774.7 +/- 3,197.4 travel miles, 46.3 +/- 53.3 hour or driving time, and \$1,151.50 +/- \$1,326.90 in travel reimbursement) 	Veterans only, participants were 92.3% male and 69.2% 64 years old or less, convenience sample.
Holmes M, Clark S. ⁹	<ul style="list-style-type: none"> • Satisfied (high, patients liked the self-manage aspect) • Effective (participants lost weight, outcomes improved, readmissions decreased from 12 to 4) • Efficient (average cost per patient 68.86 British pounds) 	Small sample size (n=12).
Levy N, et al. ¹⁰	<ul style="list-style-type: none"> • Highly satisfied (patients in the intervention group reported higher levels of satisfaction) • Effective (significantly more in the intervention group had reached their optimal insulin levels) • Efficient (none mentioned) 	True experiment (randomized, good sampling technique)
Moin T, et al. ¹¹	<ul style="list-style-type: none"> • Satisfied (participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle) • Effective (improved behavioral outcomes, more appropriate for women) • Efficient (none mentioned) 	Women veterans, small sample size, Computer literacy was an issue for some.
Cotrell C, et al. ¹²	<ul style="list-style-type: none"> • Satisfied (positive patient satisfaction indicators) • Effective (improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered) • Efficient (none mentioned) 	Selection bias (satisfaction with AIM appeared optimal when patients were carefully selected).
Tabak M, et al. ¹³	<ul style="list-style-type: none"> • Satisfied (satisfaction was higher with the control group than the Telehealth group) • Effective (better clinical measures in the Telehealth group) • Efficient (none mentioned) 	Small sample size (n=19).
Kim H, et al. ¹⁴	<ul style="list-style-type: none"> • Satisfied (easy to use, very convenient) • Effective (outcomes similar to in-clinic visits) • Efficient (cost \$916.64 per patient) 	Good analysis of fixed versus variable costs.

Author	Summary/Conclusion	Comments
Cancela J, et al. ¹⁵	<ul style="list-style-type: none"> • Satisfied (overall satisfaction high, but some concern over public perceptions about the wearable sensors) • Effective (for remote monitoring, wearable systems are highly effective) • Efficient (none mentioned) 	An extension of the Body Area Network (BAN) sensors.
Casey M, et al. ¹⁶	<ul style="list-style-type: none"> • Satisfied (good usability) • Effective (transformed relationships with exercise) • Efficient (none mentioned) 	Small sample size (n=12).
Tsai CH, et al. ¹⁷	<ul style="list-style-type: none"> • Satisfied (user satisfaction very high) • Effective (user perception of high quality) • Efficient (none mentioned) 	Focus was on older users and their families.
Oliveira TC, et al. ¹⁸	<ul style="list-style-type: none"> • Satisfied (positive impact on patient experience) • Effective (none mentioned) • Efficient (average time and cost of a tele-appointment is 93 minutes for Teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face) 	
Minatodani, et al. ¹⁹	<ul style="list-style-type: none"> • Satisfaction (patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes) • Effective (through Telehealth, greater self-awareness, self-efficacy, and accountability) • Efficient (feedback more efficient) 	
Akter S, et al. ²⁰	<ul style="list-style-type: none"> • Satisfied (satisfaction is related to service quality, continuance intentions, and quality of life) • Effective (none mentioned) • Efficient (mHealth should deliver higher-order, societal outcomes) 	
Hung Y, et al. ²¹	<ul style="list-style-type: none"> • Satisfied (higher use was indicative of higher satisfaction) • Effective (higher use was clinically important to outcomes) • Efficient (none mentioned) 	

Author	Summary/Conclusion	Comments
Buis LR, et al. ²²	<ul style="list-style-type: none"> • Satisfied (67.1% reported very high satisfaction) • Effective (txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise) • Efficient (low participant costs) 	
Houser SH, et al. ²³	<ul style="list-style-type: none"> • Satisfied (strong satisfaction reported for the interactive voice response system, IVRS) • Effective (patients felt informed) • Efficient (none mentioned) 	Small sample of those who received the call IVRS (n=19).
Kairy D, et al. ²⁴	<ul style="list-style-type: none"> • Satisfied (feeling an ongoing sense of support) • Effective (tailored challenging programs using Telerehabilitation) • Efficient (improved access to services with reduced need for transportation, easy to use) 	
Bishop TF, et al. ²⁵	<ul style="list-style-type: none"> • Satisfied (easier access to and better communication with provider) • Effective (patients with repeat issues of a condition are able to reset the treatment for the most recent episode) • Efficient (it takes about one minute per email, and it improves the efficiency of an office visit) 	Heavy resistance to change cited. Some providers are not technology savvy. The additional workload can take a psychological toll on providers because the work never stops.
Pietta JD, et al. ²⁶	<ul style="list-style-type: none"> • Satisfied (88% patients reported "very satisfied", 11% "mostly satisfied") • Effective (100% patients felt the interactive voice response (IVR) were helpful, 77% reported improved diet, 80% reported improved symptom monitoring, 80% reported improved medication adherence) • Efficient (none mentioned) 	Selection bias (73% women, average 6.1 years of education)
Gund A, et al. ²⁷	<ul style="list-style-type: none"> • Satisfied (parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit) • Effective (same or better outcomes because the parents did not have to bring infants in) • Efficient (nurses took less than 10 minutes of work time daily to answer questions) 	

Author	Summary/Conclusion	Comments
ter Huurne ED, et al. ²⁸	<ul style="list-style-type: none"> • Satisfied (high satisfaction) • Effective (significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only) • Efficient (none mentioned) 	
Chun, YJ & Patterson PE. ²⁹	<ul style="list-style-type: none"> • Satisfied (on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system) • Effective (none mentioned) • Efficient (task completion rate was 80% for younger group and 64.6% for older group) 	Small sample size (n=16)
Lee ACW, et al. ³⁰	<ul style="list-style-type: none"> • Satisfied (reported as high and very high) • Effective (increases access where proximity is an issue) • Efficient (links multiple providers together for Teleconsultation) 	
Saifu HN, et al. ³¹	<ul style="list-style-type: none"> • Satisfied (95% reported highest level of satisfaction) • Effective (95% reported a preference for telemedicine versus in-person visit) • Efficient (reported a significant reduction in health visit-related time, mostly due to decreased travel) 	
Lua PL, & Neni WS. ³²	<ul style="list-style-type: none"> • Satisfied (74% reported very or quite useful) • Effective (excellent modality for education, drug-taking reminder, and clinic appointment reminder) • Efficient (none mentioned) 	
Finkelstein, et al. ³³	<ul style="list-style-type: none"> • Satisfied (ninety percent of the subjects were satisfied with the home health Telehealth service) • Effective (frequency of communication increased) • Efficient (none mentioned) 	
Gibson KL, et al. ³⁴	<ul style="list-style-type: none"> • Satisfied (47% positive response, 21% neutral, 32% negative) • Effective (increased comfort in the therapeutic situation, increased usefulness) • Efficient (increased access to services) 	

Author	Summary/Conclusion	Comments
Doorenbos, et al. ³⁵	<ul style="list-style-type: none"> • Satisfied (participants reported high levels of satisfaction with support groups via videoconference) • Effective (results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors) • Efficient (none mentioned) 	<p>Selection bias (all participants were women) Rural care focus (participants were members of American Indian or Alaskan Native)</p>
Breen P, et al. ³⁶	<ul style="list-style-type: none"> • Satisfied (Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management) • Effective (Telephysiology and control groups were equally as anxious about their procedure, Telephysiology can improve access to CN services and expert opinion) • Efficient (reduced travel burden and need for overnight journeys) 	<p>Both patients and clinicians expressed satisfaction with Telephysiology</p>
Everett J & Kerr D. ³⁷	<ul style="list-style-type: none"> • Satisfied (patients reported more understanding, insight, and control by viewing data and easy access to health professional) • Effective (intervention group demonstrated improved diabetes control) • Efficient (health professional time was less than 10 minutes each day to review data and was incorporated into current workload) 	<p>Each user's home was visited to set up and demonstrate the system.</p>
Gardner-Bonneau D. ³⁸	<ul style="list-style-type: none"> • Satisfied (the intervention device was intuitive to use) • Effective (Telehealth group showed clinical improvements) • Efficient (economic analysis showed savings in the COPD Telemonitoring group, software issues caused many interventions by medical staff which consumed time) 	<p>Medical literacy became an issue when the device asked patients if their readings were normal. Small sample size (n=19 intervention, n=27 control).</p>
Shein RM, et al. ³⁹	<ul style="list-style-type: none"> • Satisfied (higher satisfaction with Telerehabilitation) • Effective (none mentioned) • Efficient (great time savings in travel) 	<p>Selection bias (89.6% Caucasian, average age was 55).</p>

160

161 Synthesis of Results

162 Every article in our sample reported patient satisfaction.⁸⁻³⁹ Many studies listed factors of
 163 both effectiveness and efficiency,^{8,9,14,18,19,22,24,25,27,29-31,34,36-38,39} but only one category was
 164 required as an inclusion criteria. The third column lists general comments and details that could
 165 point to selection bias. One study was restricted to U.S. Veterans, and in this same study,
 166 participants were 92.3% male, and another was restricted to U.S. Veteran females.^{8,11} Other
 167 studies used small sample sizes.^{9,13,16,23,29,38} One study pointed out that the investigators received
 168 more favorable results when they carefully selected their participants.¹² Another study focused
 169 on older users and their families.¹⁷ One study that spanned both the US and Mexico used a
 170 sample that was 73% female and those with an average of 6.1 years of education.²⁶ Another
 171 study that focused on rural care in American Indian and Alaskan Native was 100% female.³⁵ The
 172 last study in our sample was 89.6% Caucasian and an average age of 55.³⁹

173 Additional Analysis

174 After compiling our observations, we held another consensus meeting to help identify
 175 common themes as a narrative analysis. We identified commonalities among the various studies
 176 and compiled them into an affinity matrix to show frequency of occurrence. We then sorted this
 177 table by frequency, with the highest at the top (see Table 2). We identified 19 factors of
 178 effectiveness/efficiency and these occurred 61 times in the literature.

179 **Table 2: Affinity matrix**

Factor	Article reference number	Frequency
Improved outcomes	8-13,21,26-29,33,35,36,38	11
Ease of use	14,16,24-26,34,37,38	8
Decreased travel time	18,25,27,36,37,39	6
Low cost, or cost savings	9,14,18,22,38	5
Improved communication	15,19,25,27,33	5
Quality	17,20*,28	4
Increased access	30,34,36	3

Factor	Article reference number	Frequency
Increased self-awareness	19,22,26	3
Low time to manage	25,27,37	3
Decreased in-person visits	27,31	2
Helpful modality	31,32	2
Improved medication adherence	26,32	2
Decreased wait times	36	1
Decreased readmissions	9	1
Decreased time in appointments	31	1
Fewer miles driven	8	1
Improved self-efficacy	19	1
Improved self-management	9	1
Good modality for education	22	1

*Multiple factors mentioned in the same article

180

181 We acknowledge that frequency of occurrence does not equate to importance, but it has
 182 been used in other literature reviews as simply an issue of probability.⁴⁰⁻⁴² The factor of
 183 effectiveness/efficiency mentioned most often was *improved outcomes*; it was mentioned 11/61
 184 occurrences (18%).^{8-13,21,26-29,33,35,36,38} The factor mentioned in the literature the second most
 185 often was *ease of use*; it was mentioned 8/61 occurrences (13%).^{14,16,24-26,34,37,38} The factor
 186 mentioned next most often was *decreased travel time*; it was mentioned 6/61 occurrences
 187 (10%).^{18,25,27,36,37,39} Two factors tied for mention the fourth most often: *Low cost, or cost savings*
 188 ^{9,14,18,22,38} and *improved communication*,^{15,19,25,27,33} they were mentioned 5/61 occurrences (8%).
 189 The factor mentioned next most often was *quality*, which was a composite variable of *service*
 190 *quality*^{17,20} and *quality of life*,^{20,28} it was mentioned 4/61 occurrences (7%). Three factors tied for
 191 mention next most often: *Increased access*,^{30,34,36} *increased self-awareness*,^{19,22,26} and *low time to*
 192 *manage*,^{25,27,37} they were mentioned 3/61 occurrences (5%). Three factors tied for mention the
 193 next most often: *Decreased in-person visits*,^{27,31} *helpful modality*,^{31,32} and *improved medication*
 194 *adherence*,^{26,32} they were mentioned 2/61 occurrences (3%). Seven factors were only mentioned

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2
3 195 once in the literature: *Decreased readmissions,*⁹ *decreased time in appointments,*³¹ *decreased*
4
5 196 *wait times,*³⁶ *fewer miles driven,*⁸ *improved self-efficacy,*¹⁹ *improved self-management,*⁹ and *good*
6
7
8 197 *modality for education,*²² were only mentioned 2% of all occurrences.
9

11 198 **Discussion**

13 199 **Summary of Evidence**

15 200 Telehealth has the potential to extend the boundaries of providers' practices by
16
17 201 overcoming the barrier of proximity. This modality of care is particularly important with the
18
19 202 worldwide shortage of healthcare professionals. Our team wanted to evaluate factors of
20
21 203 effectiveness and efficiency that contribute to patient satisfaction in studies on various aspects of
22
23 204 Telehealth. We analyzed 32 studies in this literature review, identified 19 factors of
24
25 205 effectiveness/efficiency, and these factors were mentioned a total of 61 times in the literature.
26
27

29 206 Along with the introduction of a new modality of care comes change, and the literature
30
31 207 mentioned various reactions to this change. One study identified heavy resistance to change,^{17,25}
32
33 208 while others mentioned an embrace of the change.^{17,36} Older patients, in general, do not embrace
34
35 209 change, but recent studies have identified a generational acceptance of technology and mHealth
36
37 210 in general.⁴³ This study identifies more resistance to change from the very elderly, but not so
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39 211 much from the younger elderly. Such a finding gives hope to all Telehealth modalities of
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41 212 delivering care, particularly with the worldwide aging population.
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45 213 Our findings from this systematic review and narrative analysis identify some issues that
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47 214 are salient in the literature. To help overcome provider resistance to change to Telehealth, it
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49 215 should be noted that over the last five years, 18% of the factors of effectiveness in the literature
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51 216 were improved outcomes. Providers should embrace Telehealth modalities of care because it
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53 217 overcomes the barrier of proximity to reach rural patients and help them with various conditions
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55 218 and make improvements in outcome measures. Some providers have noted that Telehealth can be
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3 219 very efficient to manage, and it can make in-clinic visits more productive. Patients should
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5 220 embrace Telehealth modalities because it can be easy to use, it can decrease travel time and
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8 221 increase communication with providers. Telehealth can provide a high quality service, increase
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10 222 access to care, increase self-awareness. It enables patients to be empowered, to self-manage
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12 223 chronic conditions, to make improvements in both physical and behavioral conditions.
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14 224 Healthcare organizations should embrace Telehealth because the organizational can extend its
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16 225 influence without having to increase its physical footprint. But most importantly, policy makers
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18 226 need to help legislation catch up with the technology by enabling additional means of
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20 227 reimbursement for Telehealth. Providers can be more efficient and extend their boundaries of
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22 228 care very efficiently through Telehealth, but this does not mean that they should do it for free. If
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24 229 an in-clinic visit can be saved through a Telehealth intervention, that does not eliminate the need
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26 230 to pay the provider for his/her efforts.

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29 231 The main focus of our review was Telehealth and its association with patient satisfaction.
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32 232 Healthcare services provided through Telehealth supplant those same services delivered in-
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34 233 person, and some patients feel this has a negative effect on patient-provider interaction, while
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36 234 other patients are enthusiastically positive about the services that were delivered through
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38 235 Telehealth. The modality of Telehealth seems to cause mixed reactions on the issue of patient
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40 236 satisfaction. It can lead some people to believe that it is too impersonal, while others believe it is
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42 237 a proper and appropriate method of care.

48 238 **Comparison**

49 239 The results of our review and narrative analysis are consistent with other reviews. Health
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51 240 outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple
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53 241 studies,⁴⁴ Improvements have been identified for both physical and behavioral conditions.
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55 242 However, in deference to this review, our study identified a decrease in utilization of physical
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3 243 clinics. The review by de Jong et al., did not identify a significant decrease in utilization.⁴⁴ This
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5 244 review also focused on interventions that used asynchronous communication, like email and text
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8 245 messages, with an older population. Our study included both asynchronous and synchronous
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10 246 interventions with all ages.

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13 247 We were able to locate a study from 2011 that also evaluated Telehealth and patient
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15 248 satisfaction.⁴⁵ The researchers used secondary data analysis as the basis for their study. Their
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17 249 study focused on patient satisfaction and home Telehealth in US Veterans. Similar to the de Jong
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20 250 review, this study focused on an older population ranging from 55-87, while our analysis
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22 251 included younger age groups. Its focus on US Veterans while ours included this group as only
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24 252 part of our population. Our approach can equate to a greater external validity to our analysis. The
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26
27 253 Young et al. review found that its participants were extremely satisfied with the care
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29 254 coordination/home Telehealth (CCHT) program. The US Veterans in this review embraced the
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32 255 new modality. The researchers found a decrease in utilization associated with the Telehealth
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34 256 modality.

35 36 37 257 **Limitations**

38 258 We identified several limitations in the conduct of our literature review and narrative
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41 259 analysis. Selection bias is a factor that is important to consider. To limit selection bias, our group
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43 260 of reviewers met multiple times to agree on standard definitions and goals of the project, and we
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45 261 held consensus meetings to discuss our findings and inspire additional thought and analysis. We
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48 262 also had multiple reviewers read each study in our sample and record their observations. This
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50 263 enabled us to decide as a group the details of observation and factors for analysis.

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53 264 Another important consideration is publication bias. Our search focused on two popular
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55 265 research indices: PubMed (MEDLINE) and CINAHL (by Ebsco Host). We did not reach out to
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57 266 indices of theses and dissertations. By focusing on PubMed and CINAHL, we capture only peer-

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3 267 reviewed, published articles, but the drawback to this approach is that journals tend to publish
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5 268 only significant findings. Studies that did not show statistical significance in research questions
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8 269 are not usually published. We also did not use Google Scholar. This was a deliberate choice. In
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10 270 our experience, searches in Google Scholar tends to present a large number of false positives due
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13 271 to its primitive filtering capability.

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15 272 We controlled for inter-rater reliability through the initial focus study of the topic
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17 273 followed by several consensus meetings held along the iterative process. By continuing to review
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20 274 our findings, we follow the example of other reviews and narrative analyses.⁴⁰⁻⁴³

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22 275 The final limitation that we identified was the young age of the Telehealth modality of
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24 276 care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young.
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27 277 Because it technologically based, we chose to only look at the last five years, which could also
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29 278 limit our findings, but the rapid advancement of a technologically-based modality drives a more
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32 279 recent sample to make current observations and conclusions.

33 34 35 280 **Conclusions**

36 281 Overall, it was found that patient satisfaction can be associated with the modality of
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38 282 Telehealth, but factors of effectiveness and efficiency are mixed. We found that patients'
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41 283 expectations were met when providers delivered healthcare via videoconference or any other
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43 284 Telehealth method. Telehealth is a feasible option for providers who want to expand their
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45 285 practices to remote areas without having to relocate or expand their footprint of their practice. As
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48 286 Telehealth continues to be developed, special care should be given to incorporate features that
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50 287 enable acceptance and reimbursement of this modality.

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53 54 55 289 **List of abbreviations**

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57 290 AIM: Advice and interactive messaging system
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3 291 BAN: Body area network
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6 292 CCHT: Care coordination/home Telehealth
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8 293 CINAHL: Cumulative index of nursing and allied health literature
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11 294 CVT: Clinical Video Teleconferencing
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13 295 EBSCO Host: Elton B Stephens Company
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15 296 HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems
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17 297 HEDIS: Healthcare Effectiveness Data and Information Set
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20 298 IVRS: Interactive voice response system
21
22 299 MEDLINE: U.S. National Library of Medicine bibliographic database
23
24 300 MeSH: Medical subject headings from the U.S. Library of Medicine
25
26
27 301 PPACA: Patient Protection and Affordable Care Act
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29 302 WHO: World Health Organization
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31
32 **303 Acknowledgements**

33
34 304 We would like to acknowledge Texas State University for using their library database for our
35
36 305 research.

37
38 306 **Ethics approval and consent to participate:** Not applicable

39
40 307 No humans or animals were involved in this study; therefore this study is categorized as IRB

41
42 308 Exempt in 45CFR46.

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44 309 **Consent for publication:** Not applicable

45
46 310 **Availability of data and materials:** Not applicable

47
48 311 All data and materials used in the creation of this manuscript are included in the appendices

49
50 312 **Competing interests:** Not applicable. No competing financial interest exist.

51
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3 314 **Authors' contributions**
4

5 315 The contributions of the six-member team meet the requirements for authorship. CK directed the
6
7
8 316 initial research, served as lead author, mediated discussions about the merit of abstracts/articles,
9
10 317 integrated the input from all team members, and helped refine the figure and tables to provide
11
12 318 continuity and flow. NK contributed the initial draft of the introduction, and integrated her
13
14 319 viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR
15
16 320 contributed the initial draft of the abstract, and she integrated her viewpoints into the methods,
17
18 321 discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the
19
20 322 initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the
21
22 323 initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB
23
24
25 324 served as an expert in research in U.S. Veterans due to his research in this area, and he
26
27 325 contributed meaningful contribution to the formation of analysis and conclusion.
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PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2 for each meta-analysis).	



PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

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Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

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3 1 **Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis**

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1
2
3 **30 Abstract**
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5 **31** *Background:* The use of telehealth steadily increases as it has become a viable modality to
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8 **32** patient care. Early adopters attempt to use telehealth to deliver high quality care. Patient
9
10 **33** satisfaction is a key indicator of how well the telemedicine modality met patient expectations.

11
12 **34** *Objective:* The objective of this systematic review and narrative analysis is to explore the
13
14
15 **35** association of telehealth and patient satisfaction in regards to effectiveness and efficiency.

16
17 **36** *Methods:* Boolean expressions between key words created a complex search string. Variations of
18
19
20 **37** this string were used in CINAHL and MEDLINE because the databases index differently. The
21
22 **38** initial result of 2193 articles was filtered several times, and remaining articles were reviewed by
23
24 **39** multiple reviewers. Key points were summarized independently, then the authors discussed the
25
26 **40** merits of each article to reach consensus.

27
28
29 **41** *Results:* The studies chosen expressed patient satisfaction through a mixture of 119 factors of
30
31 **42** effectiveness and efficiency associated with the telehealth intervention (n=44). The factors listed
32
33
34 **43** most often were improved outcomes (20%), preferred modality (10%), ease of use (9%), low
35
36 **44** cost 8%), improved communication (8%), and decreased travel time (7%); which in total
37
38 **45** accounted for 61% of occurrences.

39
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41 **46** *Conclusion:* This review identified a variety of factors of association between telehealth and
42
43
44 **47** patient satisfaction. As telehealth technology grows, additional work should be performed to
45
46 **48** ensure patient satisfaction is at least as high as with more traditional modalities.

47
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49
50 **50** Key words: patient satisfaction; telehealth; telemedicine; quality; access; patient quality;
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52 **51** telecommunications; home telehealth.

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53 **Strengths and limitations of this study**

54 Strengths

- 55 • Uses PRISMA standard
- 56 • Sample size >30 selected with MeSH key terms in established research databases
- 57 • Multiple reviewers met several times to control for selection bias and to increase inter-
58 rater reliability

59 Limitations

- 60 • Telehealth, in general, is a relatively new topic in medicine (since 1990s), which makes it
61 difficult to assess trends over time
- 62 • Publication bias is difficult to control for

64 **Introduction**

65 **Rationale**

66 The mental image of medical house calls is one of archaic practices in small towns and
67 otherwise rural communities, or something associated with concierge medicine. However,
68 telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to
69 more technological-delivered services, making it possible to receive healthcare services from the
70 comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot
71 before one's appointment. This review examines telehealth and any association it might have
72 with patient satisfaction.

73 This review uses the definition of telehealth from the World Health Organization:

74 The delivery of health care services, where distance is a critical factor, by all health care
75 professionals using information and communication technologies, for the exchange of
76 valid information for diagnosis, treatment, and prevention of disease and injuries,

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2
3 77 research and evaluation, and for the continuing education of health care providers, in all
4
5 78 the interests of advancing the health of individuals and their communities.¹
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8 79 Following the WHO's example, we did not distinguish between telehealth and telemedicine;
9
10 80 instead we used the term telehealth to address both telehealth and telemedicine.¹ This broad
11
12 81 definition of telehealth encompasses several modes of delivery, such as videoconferencing,
13
14 82 mobile applications, and secure messaging. The WHO recognizes several branches of
15
16 83 telemedicine: teleradiology, teledermatology, telepathology, and telepsychology.¹ With the
17
18 84 increase use of technology in healthcare, there has been a great emphasis on telehealth because it
19
20 85 can extend the services of providers to remote locations and capitalize on the availability of
21
22 86 subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it
23
24 87 has the potential of making healthcare services more convenient for patients, especially those in
25
26 88 rural areas, those with small children (child care), and those with mobility restrictions.^{2,3}
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31 89 Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of
32
33 90 the customer, it is a measure of quality that is published in the US through its Healthcare
34
35 91 Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the
36
37 92 Center for Medicare and Medicaid through results of Hospital Consumer Assessment of
38
39 93 Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare
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41 94 delivery, telehealth relies heavily on reports of patient satisfaction because the patients are the
42
43 95 only source of information that can report how they were treated and if the treatment received
44
45 96 met the patients' expectations of care.^{4,5} If the patients are not happy with their healthcare
46
47 97 services being provided remotely, the service becomes redundant and expensive. With the
48
49 98 increase in prevalence of telehealth, it is important to maintain the key quality indicator of
50
51 99 patient satisfaction regardless of modality of delivery. The voice of the customer needs to be
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3 100 continuously heard so that telehealth developers can exercise agility in the development process
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5 101 while the healthcare organization continues to develop more technology-based care that meets
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8 102 the needs of patients and providers. The technology base inherent to telehealth dramatically
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10
11 103 changes the mode of delivery, but a strong patient-to-provider relationship must be maintained
12
13 104 independent of the modality. A definition of patient satisfaction, effectiveness, and efficiency are
14
15 105 provided at the end of the manuscript.
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17

18 106 **Objective**

19 107 We had multiple research questions. R1: Is there an association of telehealth with patient
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22 108 satisfaction? R2: Are there common facilitators of either efficiency or effectiveness mentioned in
23
24 109 the literature that would provide a positive or negative association between telehealth and patient
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26 110 satisfaction?
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30 111 **Methods**

31 112 *Protocol*

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33
34 113 To create the basic organization for this review, we looked to the Preferred Reporting
35
36 114 Items for Systematic Reviews and Meta-Analyses (PRISMA).⁶ Telehealth has rapidly changed
37
38 115 and evolved since it first appeared as an index item for PubMed in 1987, which guided our
39
40
41 116 research to reflect the current state of telehealth and its relationship with patient satisfaction and
42
43 117 indicators of effectiveness and efficiency. Our group wanted to identify an association of
44
45 118 telehealth with patient satisfaction.
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48 119 *Information sources*

49
50 120 The two sources of data were the Cumulative Index of Nursing and Allied Health
51
52 121 Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE). These sources were chosen
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55 122 due to their common use in social sciences research and because their use was observed in other
56
57 123 systematic reviews.
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3 124 *Search*
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5 125 We used a variety of key search terms, as listed in the Medical Subject Headings (MeSH)
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7
8 126 combined with Boolean operators. Search strings for the two research databases differed because
9
10 127 of the differences in the indexing methods used by each database. PubMed indexes the following
11
12 128 under the heading of telemedicine: telerehabilitation, teleradiology, telepathology, and remote
13
14 129 consultation. CINAHL does not automatically index these terms together so they were searched
15
16 130 for by name. The initial search in PubMed was (telemedicine OR telehealth) AND “Patient
17
18 131 Satisfaction.”
19

20
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22 132 *Study selectin*
23

24 133 Inclusion criteria were: 2010 through 2017, English only, full text available, and human
25
26 134 research. We also filtered for all but academic publications (peer-reviewed in CINAHL) and in
27
28 135 CINAHL we excluded Medline to eliminate the duplicates already captured in PubMed. Instead
29
30 136 of including reviews in the analysis, two reviews of similar topic were earmarked for later
31
32 137 comparison with our own results in the discussion section.
33

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35
36 138 *Data collection process*
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38
39 139 Prior to reading and analyzing articles, our team of six reviewers agreed on common
40
41 140 concepts of both telehealth and patient satisfaction. Before reviewing abstracts for germaneness
42
43 141 to our objective, we agreed on qualities to look for. Before reading the articles we agreed on
44
45 142 themes to look for. Discussion sessions and consensus meetings were held to increase the inter-
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47 143 rater reliability of the group as they conducted the screening and analysis.
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53 145 To control for selection bias, multiple reviewers in the group independently assessed the
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55 146 nature of the abstracts from the sample to determine whether they were germane to our review.
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3 147 The reviewers met to discuss the merits of each abstract and reached consensus ($Kappa=1.0$,
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5 148 high level of agreement) on the final selection of abstracts. The references of these articles were
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8 149 reviewed for other articles that might have been missed in our initial search; if multiple articles
9
10 150 used a source that we did not already identify, then it was added to the sample. The final set of
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12 151 articles was then divided among reviewers to ensure that at least 2 reviewers read each article.
13
14
15 152 Reviewers read and made observations independently.

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17 153 Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a
18
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20 154 literature matrix. Another consensus meeting was conducted to discuss findings and make
21
22 155 inferences. During the consensus meeting, individual observations were discussed and combined
23
24 156 into similar groupings throughout the sample to simplify our assessment of associations. This is a
25
26
27 157 form of narrative analysis and sensemaking.⁷ Observations of effectiveness and efficiency were
28
29 158 combined and sorted into an affinity matrix for final analysis.

30 31 32 159 *Data items and summary measures*

33
34 160 Our litmus test was to include articles that included a combination of telehealth and
35
36 161 patient satisfaction, and a measure or assessment of effectiveness or efficiency. We eliminated
37
38 162 those that fell short of those goals.

39 40 41 163 *Risk of bias in individual studies and risk of bias across studies*

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43 164 Bias was discussed during consensus meetings. The consensus meetings served as a
44
45 165 control on our own selection bias and selective reporting within studies.

46 47 48 166 *Summary measures and synthesis of results*

49
50 167 Our review examines articles that combine telehealth intervention with patient
51
52 168 satisfaction and include some mention of effectiveness or efficiency. A physical count of these
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54 169 observations was made. After all observations were combined into an Excel file, and after all
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170 observations were condensed into themes of effectiveness or efficiency, all themes were
 171 displayed in an affinity matrix to identify the number of occurrences of each theme. These will
 172 be sorted by frequency.

173 Results

174 Study Selection, Study Characteristics and Results of Individual Studies

175 Our search process is illustrated in Figure 1.

176 Figure 1: Literature Search process with inclusion and exclusion criteria

177
 178 The initial search with key words only resulted in 2193 results. We used several filters such as
 179 year published, which reduced the results to 193. Through a careful screening process, each
 180 abstract was reviewed by at least two reviewers. We all made independent recommendations on
 181 whether to include or not include. Then we met to discuss our recommendations. Through this
 182 consensus meeting we reduced the sample to 44.

183 Table 1 lists a summary of our analysis and observations from our team (n=44). For every
 184 article/study in the sample, we made observations for *satisfied*, which was a screening criteria,
 185 and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the
 186 top. The reference numbers correspond to those in the references section.

187 **Table 1: Compilation of observations for our sample**

Author	Summary/Conclusion	Comments and Observations of Bias
Schulz-Heik, et al. ⁸	Clinical yoga with VA population Satisfaction: Participants' satisfaction did not differ from the control group Effectiveness: Participants' 16 specific health outcomes did not differ from the control group	VA population in Palo Alto only

Iqbal A, et al. ⁹	Ileostomy pts at University of Florida provided with an education and mgt protocol plus a daily telephone call for 3 weeks after discharge (n=38). Satisfaction reported 4.69 (1-5 scale). Effective: Readmission rates decreased from 65% to 16% from the control group saving \$63,821	Satisfactory sample size Limited to one area of the country and beneficiaries to one university health system
Muller KI, et al. ¹⁰	Using telehealth to diagnose and treat nonacute headaches (n=200) Satisfied: Patients satisfied with video and sound quality. Intervention group's consultations shorter than control group. Efficient: Median travel distance for rural pts was 7.8 hours, cost E249, lost income E234 per visit (saved).	Nonacute headache patients from Northern Norway Strong sample size pts randomized
Dias AE, et al. ¹¹	Voice rehabilitation in Parkinson's Disease (n=20) satisfaction: high Effective: preference for telehealth intervention	small sample
Langabeer JR, et al. ¹²	Telehealth enabled EMS services program to reduce transport of lower acuity pts to ED in Houston (n=5,570). Satisfaction: no decrease Efficient: 56% reduction in ambulance transports and 53% decrease in response time for the intervention group than the control. No difference in patient satisfaction.	Strong sample size Limited to pts regional to Houston, Texas No randomization
Hoas H, et al. ¹³	Adherence and factors affecting satisfaction in long-term rehabilitation for patients with chronic COPD in Norway (n=10). Satisfaction: Telemonitoring and self-management combined with weekly videoconferencing with physiotherapist. Effective: Increased health benefits, self-efficacy, independence, emotional safety, and maintenance of motivation	Small sample Over 2 years
Jacobs JJ, et al. ¹⁴	Patient satisfaction with teleradiology service in general practice in Netherlands	rural health

	Satisfaction: Island residents, the elderly, and those with no history of trauma were more satisfied with the technical and interpersonal aspects of the teleconsultation than non-residents, younger patients, and those with history of trauma.	
Bradbury A, et al. ¹⁵	Utilizing remote real-time videoconferencing to expand access to cancer genetic services in community practices (n=41) Satisfaction: All patients reported satisfaction and knowledge increased significantly. Effective: General anxiety and depression decreased	University of Pennsylvania, Philadelphia
Alazab R, & Khader Y. ¹⁶	Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life (n=64) Satisfaction: Patient satisfaction mean = 96.8 Effective: Mean SF8 score increased significantly (physical components of quality of life)	rural health
Fields BG, et al. ¹⁷	Remote ambulatory management of veterans with obstructive sleep apnea (n=60) Satisfaction: No difference in functional outcomes, patient satisfaction, dropout rates, or objectively measured PAP adherence. Effective: Telemedicine participants showed greater improvement in mental health scores and their feedback was positive.	Veterans in the Philadelphia area only
Georgsson M, & Staggars N. ¹⁸	Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with association user characteristics in the US and Sweden (n=10) Satisfaction: good Effective: Good but not excellent usability Males were more successful in task completion, and younger participants had higher performance scores. Level of education had no effect, but recency of diagnosis of diabetes did. Patients with more experience with IT also had higher performance scores.	small sample size
Polinski JM, et al. ¹⁹	Patients' satisfaction with and preference for telehealth visits (n=1734) Satisfaction: 33% preferred telehealth visits to traditional in-person visits. Women preferred telehealth visits. Efficient: Telehealth increased access to care. Lack of insurance increased odds of preferring telehealth.	70% women

	Efficient: Other positive predictors were quality of care received, telehealth convenience, understanding of telehealth	
Levy EL, et al. ²⁰	Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. Satisfied: all but one participant reported satisfied or highly-satisfied Effective: participants demonstrated significant improvement in most outcomes measures Efficient: participants avoided 2,774.7 +/- 3,197.4 travel miles, 46.3 +/- 53.3 hours of driving time, and \$1,151.50 +/- \$1,326.90 in travel reimbursement	veterans only, convenience sample participants were 92.3% male and 69.2% 64 years old or less
Holmes M, Clark S. ²¹	Technology-enabled care services: novel method of managing liver disease (n=12). Satisfied: high, patients liked the self-manage aspect Effective: participants lost weight, outcomes improved, readmissions decreased from 12 to 4 Efficient: average cost per patient 68.86 British pounds	Small sample size
Levy N, et al. ²²	The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. Highly satisfied: patients in the intervention group reported higher levels of satisfaction Effective: significantly more in the intervention group had reached their optimal insulin levels	True experiment (randomized, good sampling technique)
Moin T, et al. ²³	Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. Satisfied: participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle Effective: improved behavioral outcomes, more appropriate for women	Women veterans, small sample size, Computer literacy was an issue for some.
Cotrell C, et al. ²⁴	Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. Satisfied: positive patient satisfaction indicators Effective: improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered	Selection bias (satisfaction with AIM appeared optimal when patients were carefully selected).

1 2 3 4 5 6 7 8 9 10 11	Tabak M, et al. ²⁵	A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial (n=19). Satisfied: satisfaction was higher with the control group than the telehealth group Effective: better clinical measures in the telehealth group	Small sample size Strong study design
12 13 14 15 16 17 18	Kim H, et al. ²⁶	Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets (n=20 visits for 45 patients). Satisfied: easy to use, very convenient Effective: outcomes similar to in-clinic visits Efficient: cost \$916.64 per patient	Good analysis of fixed versus variable costs.
19 20 21 22 23 24 25 26 27	Cancela J, et al. ²⁷	Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors (n=32). Satisfied: overall satisfaction high, but some concern over public perceptions about the wearable sensors Effective: for remote monitoring, wearable systems are highly effective Efficient:	An extension of the Body Area Network (BAN) sensors.
28 29 30 31 32 33	Casey M, et al. ²⁸	Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care (n=12). Satisfied: good usability Effective: transformed relationships with exercise	Small sample size
34 35 36 37 38	Tsai CH, et al. ²⁹	Influences of satisfaction with telecare and family trust in older Taiwanese people (n=60). Satisfied: user satisfaction very high Effective: user perception of high quality	Focus was on older users and their families.
39 40 41 42 43 44 45 46	Oliveira TC, et al. ³⁰	Telemedicine in Alentejo Satisfied: positive impact on patient experience Effective: Efficient: average time and cost of a tele-appointment is 93 minutes for teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face	Participants are older and less educated than the rest of the population of Portugal.
47 48 49 50 51 52 53 54 55 56 57 58 59 60	Minatodani, et al. ³¹	Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. Satisfaction: patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes Effective: through telehealth, greater self-awareness, self-efficacy, and accountability	

	Efficient: feedback more efficient	
Akter S, et al. ³²	Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. Satisfied: satisfaction is related to service quality, continuance intentions, and quality of life Effective: mHealth should deliver higher-order, societal outcomes	
Hung Y, et al. ³³	Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. Satisfied: higher use was indicative of higher satisfaction Effective: higher use was clinically important to outcomes	
Buis LR, et al. ³⁴	Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy (n=159). Satisfied: 67.1% reported very high satisfaction Effective: txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise Efficient: low participant costs	Michigan and Cincinnati only
Houser SH, et al. ³⁵	Telephone follow-up in primary care: can interactive voice response calls work (n=19)? Satisfied: strong satisfaction reported for the interactive voice response system, IVRS Effective: patients felt informed	Small sample of those who received the call IVRS
Kairy D, et al. ³⁶	The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty (n=5). Satisfied: feeling an ongoing sense of support Effective: tailored challenging programs using telerehabilitation Efficient: improved access to services with reduced need for transportation, easy to use	Convenience sample. Single case. Small sample. Retrospective (asked participants to reflect on the last 8 weeks of treatment)
Bishop TF, et al. ³⁷	Electronic communication improves access, but barriers to its widespread adoption remain. Satisfied: easier access to and better communication with provider Effective: patients with repeat issues of a condition are able to reset the treatment for the most recent episode	New York City only. Heavy resistance to change cited. Some providers are not technology saavy.

	Efficient: it takes about one minute per email, and it improves the efficiency of an office visit	The additional workload can take a psychological toll on providers because the work never stops.
Pietta JD, et al. ³⁸	Satisfied: 88% patients reported "very satisfied", 11% "mostly satisfied" Effective: 100% patients felt the interactive voice response: IVR were helpful, 77% reported improved diet, 80% reported improved symptom monitoring, 80% reported improved medication adherence	Selection bias (73% women, average 6.1 years of education)
Gund A, et al. ³⁹	A randomized controlled study about the use of eHealth in the home health care of premature infants (n=13, 12, 9). Three groups were compared. Satisfied: parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit Effective: same or better outcomes because the parents did not have to bring infants in Efficient: nurses took less than 10 minutes of work time daily to answer questions	Randomization used. Semi-structured interviews were only used for 16 families.
ter Huurne ED, et al. ⁴⁰	Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study (n=89). Satisfied: high satisfaction Effective: significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only	Not all participants reported the same diagnoses. Strong pre-post design.
Chun, YJ & Patterson PE. ⁴¹	A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system (n=16). Satisfied: on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system Effective: Efficient: task completion rate was 80% for younger group and 64.6% for older group	Small sample size

1 2 3 4 5 6 7 8 9 10 11 12	Lee AC, et al. ⁴²	The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation. Satisfied: reported as high and very high Effective: increases access where proximity is an issue Efficient: links multiple providers together for teleconsultation	
13 14 15 16 17 18 19 20	Saifu HN, et al. ⁴³	Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics (c=43). Satisfied: 95% reported highest level of satisfaction Effective: 95% reported a preference for telemedicine versus in-person visit Efficient: reported a significant reduction in health visit-related time, mostly due to decreased travel	Veterans in Los Angeles CA only Convenience sample
21 22 23 24 25 26 27 28 29 30 31	Lua PL, & Neni WS. ⁴⁴	Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia (n=51). Satisfied: 74% reported very or quite useful Effective: excellent modality for education, drug-taking reminder, and clinic appointment reminder	Good mix of genders, homo-ethnic sample (92.2% Malay) median age 25 (younger may already be more receptive to technology)
32 33 34 35 36 37 38	Finkelstein, et al. ⁴⁵	Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. Satisfied: ninety percent of the subjects were satisfied with the home health telehealth service Effective: frequency of communication increased	Very limited population
39 40 41 42 43 44 45 46	Gibson KL, et al. ⁴⁶	Conversations on telemental health: listening to remote and rural First Nations communities. Satisfied: 47% positive response, 21% neutral, 32% negative Effective: increased comfort in the therapeutic situation, increased usefulness Efficient: increased access to services	First-nations communities only
47 48 49 50 51 52 53 54 55 56 57 58	Doorenbos, et al. ⁴⁷	Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities (n=32). Satisfied: participants reported high levels of satisfaction with support groups via videoconference Effective: results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors	Selection bias (all participants were women) Rural care focus (participants were members of American Indian or Alaskan Native

Breen P, et al. ⁴⁸	Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part II: the referring clinician and patient perspective. Satisfied: Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management (n=9 physicians, 116 patients). Effective: telephysiology and control groups were equally as anxious about their procedure, telephysiology can improve access to CN services and expert opinion Efficient: reduced travel burden and need for overnight journeys	Small sample of physicians. Both patients and clinicians expressed satisfaction with telephysiology
Everett J & Kerr D. ⁴⁹	Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. Satisfied: patients reported more understanding, insight, and control by viewing data and easy access to health professional Effective: intervention group demonstrated improved diabetes control Efficient: health professional time was less than 10 minutes each day to review data and was incorporated into current workload	Each user's home was visited to set up and demonstrate the system.
Gardner-Bonneau D. ⁵⁰	Remote Patient Monitoring: A Human Factors Assessment (n=27 control, n=19 intervention). Satisfied: the intervention device was intuitive to use Effective: telehealth group showed clinical improvements Efficient: economic analysis showed savings in the COPD telemonitoring group, software issues caused many interventions by medical staff which consumed time	Medical literacy became an issue when the device asked patients if their readings were normal. Small sample size
Shein RM, et al. ⁵¹	Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. Satisfied: higher satisfaction with telerehabilitation Efficient: great time savings in travel	Selection bias (89.6% Caucasian, average age was 55).

188

189 Synthesis of Results

190 Every article in our sample reported patient satisfaction.⁸⁻⁵¹ Many studies listed factors of
 191 both effectiveness and efficiency,^{20,21,26,30,31,34,36,37,39,41-43,46,48-50,51} but only one category was
 192 required as an inclusion criteria. The third column lists comments and details that could point to
 193 selection bias. One study was restricted to U.S. Veterans, and in this same study, participants

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3 194 were 92.3% male, and another was restricted to U.S. Veteran females.^{20,23} Other studies used
4
5 195 small sample sizes.^{21,25,28,35,41,50} One study pointed out that the investigators received more
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8 196 favorable results when they carefully selected their participants.²⁴ Another study focused on
9
10 197 older users and their families.²⁹ One study that spanned both the US and Mexico used a sample
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12 198 that was 73% female and those with an average of 6.1 years of education.³⁸ Another study that
13
14 199 focused on rural care in American Indian and Alaskan Native was 100% female.⁴⁷ The last study
15
16 200 in our sample was 89.6% Caucasian and an average age of 55.⁵¹
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201 Additional Analysis

202 Table 2 is the result of the additional analysis listed in the Methods section. Through a
23
24 203 narrative analysis we identified commonalities among the various studies (19 factors) and
25
26 204 compiled them into an affinity matrix to show frequency of occurrence. The matrix is sorted by
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28 205 frequency of occurrence. These 19 factors of effectiveness/efficiency occurred 119 times in the
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30 206 literature.
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207 Table 2: Affinity matrix

Factor	Article reference number	Frequency
Improved outcomes	8,9,11,13,15-17,18,20-26,31-33,38-41,47,50	24
Preferred modality	8,9,11,14,15,19,22,26,34,43,44,46	12
Ease of use	18,19,23,26,28,36-38,46,49,50	11
low cost, or cost savings	10,14,16,20,21,23,26,34,50	9
Improved communication	24,27,31,36,37,39,42,45,49	9
Travel time	10,12,20,30,36,43,48,51	8
Improved self-management	13,21,23,28,31,32,48	7
Quality	16,19,29,32,40	5
Increased access	19,42,46,48	4
Increased self-awareness	31,34,35,38	4
Decreased wait times	16,43,48,49	4
Fewer miles driven	10,14,20,51	4
Decreased in-person visits	12,39,43	3
Improved self-efficacy	13,23,31	3
Good modality for education	15,34,44	3

Low time to manage	37,39,49	3
Improved medication adherence	13,38,44	3
Decreased readmissions	9,21	2
Fewer missed appointments	44	1
		119

208

209 We acknowledge that frequency of occurrence does not equate to importance, but it has

210 been used in other literature reviews as simply an issue of probability.⁵²⁻⁵⁴ The factor of

211 effectiveness/efficiency mentioned most often was *improved outcomes*; it was mentioned 24/119

212 occurrences (20%).^{8,9,11,13,15-17,18,20-26,31-33,38-41,47,50} The factor mentioned in the literature the

213 second most often was *preferred modality*; it was mentioned 12/119 occurrences

214 (10%).^{8,9,11,14,15,19,22,26,34,43,44,46} The factor mentioned in the literature the next most often was *ease*

215 *of use*; it was mentioned 11/119 occurrences (9%).^{18,19,23,26,28,36-38,46,49,50} The factors mentioned

216 next most often was *low cost* or *cost savings*^{10,14,16,20,21,23,26,34,50} and *improved*

217 *communication*;^{24,27,31,36,37,39,42,45,49} they were mentioned 9/119 occurrences (8%). The factor

218 mentioned in the literature the next most often was *decreased travel time*; it was mentioned

219 8/119 occurrences (7%).^{10,12,20,30,36,43,48,51} The factor mentioned in the literature the next most

220 often was *improved self-management*; it was mentioned 7/119 occurrences (6%).^{13,21,23,28,31,32,48}

221 The factor mentioned in the literature the next most often was *quality*, which was a composite

222 variable of *service quality* and *quality of life*; it was mentioned 5/119 occurrences

223 (4%).^{16,19,29,32,40} Four factors tied for mention the next most often: *improved access*,^{19,42,46,48}

224 *increased self-awareness*,^{31,34,35,38} *decreased wait times*,^{16,43,48,49} and *fewer miles driven*;^{10,14,20,51}

225 they were mentioned 4/119 occurrences (3%). The next five factors were mentioned next most

226 often in the literature: *decreased in-person visits*,^{12,39,43} *improved self-efficacy*,^{13,23,31} *good*

227 *modality for education*,^{15,34,44} *low time to manage*,^{37,39,49} and *improved medication/protocol*

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2
3 228 *adherence*;^{13,38,44} they were each mentioned 3/119 occurrences (3%). *Decreased readmissions*^{9,21}
4
5 229 and *fewer missed appointments*⁴⁴ were mentioned 2/119 (2%) and 1/119 (1%), respectively.
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8 230 **Discussion**

9 231 **Summary of Evidence**

10 232 Telehealth has the potential to extend the boundaries of providers' practices by
11
12 233 overcoming the barrier of proximity. This modality of care is particularly important with the
13
14 234 worldwide shortage of healthcare professionals. Our team wanted to evaluate factors of
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16 235 effectiveness and efficiency that contribute to patient satisfaction in studies on various aspects of
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18 236 telehealth. We analyzed 44 studies in this literature review, identified 19 factors of
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20 237 effectiveness/efficiency, and these factors were mentioned a total of 119 times in the literature.
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26 238 Along with the introduction of a new modality of care comes change, and the literature
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28 239 mentioned various reactions to this change. One study identified heavy resistance to change,^{29,37}
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30 240 while others^{29,48} mentioned an embrace of the change. Older patients, in general, do not embrace
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32 241 change, but recent studies have identified a generational acceptance of technology and mHealth
33
34 242 in general.⁵⁵ This study identifies more resistance to change from the very elderly, but not so
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36 243 much from the younger elderly. Such a finding gives hope to all telehealth modalities of
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38 244 delivering care, particularly with the worldwide aging population.
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43 245 Our findings from this systematic review and narrative analysis identify some issues that
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45 246 are salient in the literature. To help overcome provider resistance to change to telehealth, it
46
47 247 should be noted that over the last seven years, 20% of the factors of effectiveness in the literature
48
49 248 were improved outcomes. Providers should embrace telehealth modalities of care because it
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51 249 overcomes the barrier of proximity to reach rural patients and help them with various conditions
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53 250 and make improvements in outcome measures. Some providers have noted that telehealth can be
54
55 251 very efficient to manage, and it can make in-clinic visits more productive. Patients should
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3 252 embrace telehealth modalities because it can be easy to use, it can decrease travel time and
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6 253 increase communication with providers. Telehealth can provide a high quality service, increase
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8 254 access to care, increase self-awareness. It enables patients to be empowered, to self-manage
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10 255 chronic conditions, to make improvements in both physical and behavioral conditions.
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12
13 256 Healthcare organizations should embrace telehealth because the organizational can extend its
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15 257 influence without having to increase its physical footprint. But most importantly, policy makers
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17 258 need to help legislation catch up with the technology by enabling additional means of
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20 259 reimbursement for telehealth. Providers can be more efficient and extend their boundaries of care
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22 260 very efficiently through telehealth, but this does not mean that they should do it for free. If an in-
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24 261 clinic visit can be saved through a telehealth intervention, it does not eliminate the need to pay
25
26 262 the provider for his/her efforts.

27
28
29 263 The main focus of our review was telehealth and its association with patient satisfaction.
30
31 264 Healthcare services provided through telehealth supplant those same services delivered in-
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33 265 person, and some patients feel this has a negative effect on patient-provider interaction, while
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35 266 other patients are enthusiastically positive about the services that were delivered through
36
37 267 telehealth. The modality of telehealth seems to cause mixed reactions on the issue of patient
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39 268 satisfaction. It can lead some people to believe that it is too impersonal, while others believe it is
40
41 269 a proper and appropriate method of care.
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46 270 **Comparison**

47
48 271 The results of our review and narrative analysis are consistent with other reviews. Health
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50 272 outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple
51
52 273 studies,⁵⁶ Improvements have been identified for both physical and behavioral conditions. The
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54 274 review by de Jong et al., did not identify a significant decrease in utilization.⁵⁶ This review also
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56 275 focused on interventions that used asynchronous communication, like email and text messages,
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3 276 with an older population. Our study included both asynchronous and synchronous interventions
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6 277 with all ages.

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8 278 We were able to locate a study from 2011 that also evaluated telehealth and patient
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10 279 satisfaction.⁵⁷ The researchers used secondary data analysis as the basis for their study. Their
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12 280 study focused on patient satisfaction and home telehealth in US Veterans. Similar to the de Jong
13
14 281 review, this study focused on an older population ranging from 55-87, while our analysis
15
16 282 included younger age groups. Its focus on US Veterans while ours included this group as only
17
18 283 part of our population. Our approach can equate to a greater external validity to our analysis. The
19
20 284 Young et al. review found that its participants were extremely satisfied with the care
21
22 285 coordination/home telehealth (CCHT) program. The US Veterans in this review embraced the
23
24 286 new modality. The researchers found a decrease in utilization associated with the telehealth
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26 287 modality.

288 **Limitations**

289 We identified several limitations in the conduct of our literature review and narrative
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36 290 analysis. Selection bias is a factor that is important to consider. To limit selection bias, our group
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38 291 of reviewers met multiple times to agree on standard definitions and goals of the project, and we
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40 292 held consensus meetings to discuss our findings and inspire additional thought and analysis. We
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42 293 also had multiple reviewers read each study in our sample and record their observations. This
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44 294 enabled us to decide as a group the details of observation and factors for analysis.

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47
48 295 Another important consideration is publication bias. Our search focused on two popular
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50 296 research indices: PubMed (MEDLINE) and CINAHL (by Ebsco Host). We did not reach out to
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52 297 indices of theses and dissertations. By focusing on PubMed and CINAHL, we capture only peer-
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54 298 reviewed, published articles, but the drawback to this approach is that journals tend to publish
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56 299 only significant findings. Studies that did not show statistical significance in research questions
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2
3 300 are not usually published (publication bias). We also did not use Google Scholar. This was a
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5
6 301 deliberate choice. In our experience, searches in Google Scholar tends to present a large number
7
8 302 of false positives due to its primitive filtering capability. Limiting our search to only two
9
10 303 databases could easily have omitted valid articles for our review.

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12
13 304 We controlled for inter-rater reliability through the initial focus study of the topic
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15 305 followed by several consensus meetings held along the iterative process. By continuing to review
16
17 306 our findings, we follow the example of other reviews and narrative analyses.⁵²⁻⁵⁵

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20 307 The final limitation that we identified was the young age of the telehealth modality of
21
22 308 care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young.
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24 309 Because it technologically based, we chose to only look at the last five years, which could also
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26
27 310 limit our findings, but the rapid advancement of a technologically-based modality drives a more
28
29 311 recent sample to make current observations and conclusions.

312 **Conclusions**

313 Overall, it was found that patient satisfaction can be associated with the modality of
314 telehealth, but factors of effectiveness and efficiency are mixed. We found that patients'
315 expectations were met when providers delivered healthcare via videoconference or any other
316 telehealth method. Telehealth is a feasible option for providers who want to expand their
317 practices to remote areas without having to relocate or expand their footprint of their practice. As
318 telehealth continues to be developed, special care should be given to incorporate features that
319 enable acceptance and reimbursement of this modality.

320 **Basic definitions**

321 *Patient satisfaction:* The U.S. Center for Medicare and Medicaid Services defines this term as
322 the patient's perspective of care which can be objective and meaningful to create comparisons of
323 hospitals and other healthcare organizations.⁵⁸

324 *Effective*: successful or achieving the results that you want.⁵⁹ Usually associated with outcomes.

325 *Efficient*: performing or functioning in the best possible manner with the least waste of time and

326 effort; having and using requisite knowledge, skill, and industry.⁶⁰

327 **Data sharing statement**

328 All data are freely available

329 **List of abbreviations**

330 AIM: Advice and interactive messaging system

331 BAN: Body area network

332 CCHT: Care coordination/home telehealth

333 CINAHL: Cumulative index of nursing and allied health literature

334 CVT: Clinical Video Teleconferencing

335 EBSCO Host: Elton B Stephens Company

336 HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems

337 HEDIS: Healthcare Effectiveness Data and Information Set

338 IVRS: Interactive voice response system

339 MEDLINE: U.S. National Library of Medicine bibliographic database

340 MeSH: Medical subject headings from the U.S. Library of Medicine

341 PPACA: Patient Protection and Affordable Care Act

342 WHO: World Health Organization

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345 research.

346 **Ethics approval and consent to participate**: Not applicable

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2
3 347 No humans or animals were involved in this study; therefore this study is categorized as IRB
4
5 348 Exempt in 45CFR46.
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7
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9

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11

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13

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15

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17

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19

20 355 The contributions of the six-member team meet the requirements for authorship. CK directed the
21
22 356 initial research, served as lead author, mediated discussions about the merit of abstracts/articles,
23
24 357 integrated the input from all team members, and helped refine the figure and tables to provide
25
26 358 continuity and flow. NK contributed the initial draft of the introduction, and integrated her
27
28 359 viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR
29
30 360 contributed the initial draft of the abstract, and she integrated her viewpoints into the methods,
31
32 361 discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the
33
34 362 initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the
35
36 363 initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB
37
38 364 served as an expert in research in U.S. Veterans due to his research in this area, and he
39
40 365 contributed meaningful contribution to the formation of analysis and conclusion.
41
42
43
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45
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47

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49

50 367 **FIGURE LEGEND**
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52 368 **Figure 1: Literature Search process with inclusion and exclusion criteria**
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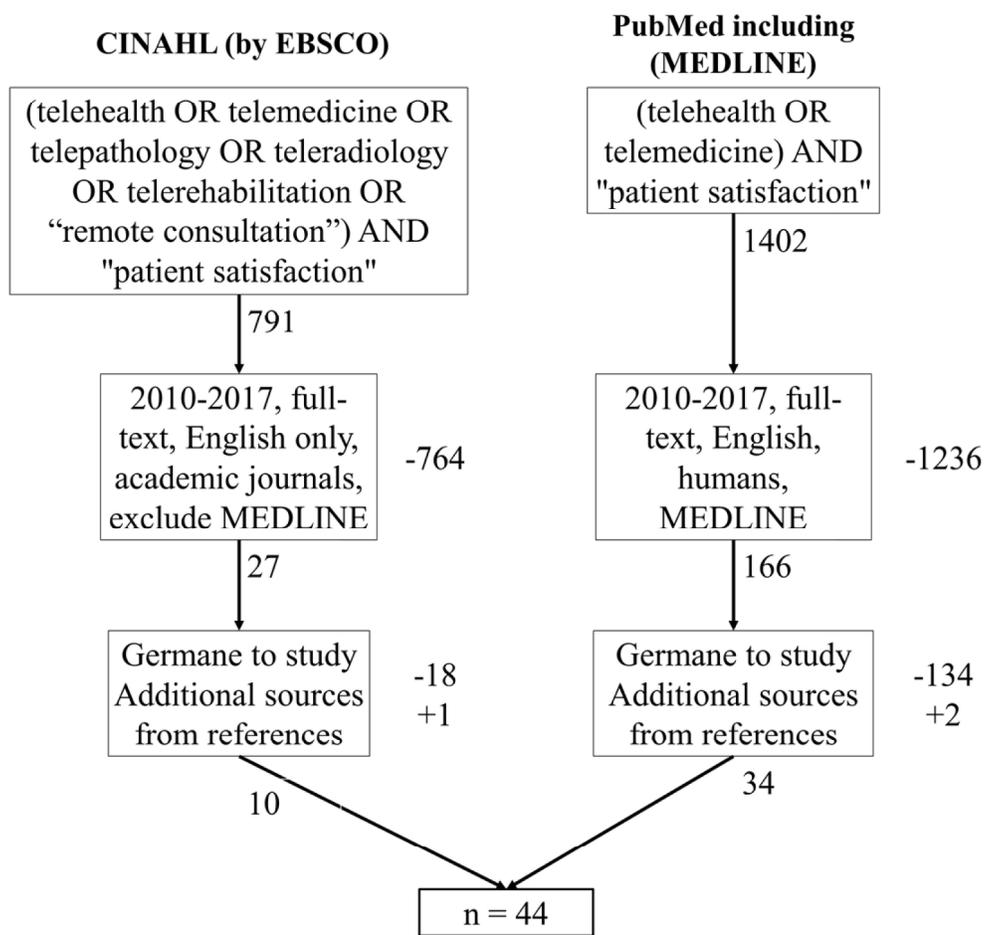
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Literature Search process with inclusion and exclusion criteria

246x236mm (300 x 300 DPI)

Preprint



PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2 for each meta-analysis).	



PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Page 2 of 2

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BMJ Open

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016242.R2
Article Type:	Research
Date Submitted by the Author:	30-May-2017
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Primary Subject Heading:	Patient-centred medicine
Secondary Subject Heading:	Qualitative research
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, patient satisfaction, telehealth

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Manuscripts

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3 1 **Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis**
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6 2 Running title: **Telehealth and Patient Satisfaction**
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3 **30 Abstract**
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5 **31** *Background:* The use of telehealth steadily increases as it has become a viable modality to
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8 **32** patient care. Early adopters attempt to use telehealth to deliver high quality care. Patient
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10 **33** satisfaction is a key indicator of how well the telemedicine modality met patient expectations.
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12 **34** *Objective:* The objective of this systematic review and narrative analysis is to explore the
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15 **35** association of telehealth and patient satisfaction in regards to effectiveness and efficiency.
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17 **36** *Methods:* Boolean expressions between key words created a complex search string. Variations of
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20 **37** this string were used in CINAHL and MEDLINE.
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22 **38** *Results:* 2193 articles were filtered and assessed for suitability (n=44). Factors relating to
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25 **39** effectiveness and efficiency were identified using consensus. The factors listed most often were
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27 **40** improved outcomes (20%), preferred modality (10%), ease of use (9%), low cost 8%), improved
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29 **41** communication (8%), and decreased travel time (7%); which in total accounted for 61% of
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32 **42** occurrences.
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34 **43** *Conclusion:* This review identified a variety of factors of association between telehealth and
35
36 **44** patient satisfaction. Knowledge of these factors could help implementers to match interventions
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39 **45** as solutions to specific problems.
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41 **46**
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43 **47** Key words: patient satisfaction; telehealth; telemedicine; quality; access; patient quality;
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46 **48** telecommunications; home telehealth.
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50 **Strengths and limitations of this study**

51 Strengths

- 52 • Inserting technology into a medical intervention should not be without deliberate design.
53 This review serves as a portent of the patient to help guard against the implementation of
54 technology merely for its convenience or shiny appeal.
- 55 • This study uses the PRISMA standard, which is an internationally recognized protocol
56 for the conduct and reporting of systematic reviews, which increases the validity of the
57 results.
- 58 • A sample size >30 selected from MeSH key terms indexed through established research
59 databases increases the reliability of the review

61 Limitations

- 62 • Published studies do not often clearly set out reasons for inserting technology into an
63 intervention, and therefore, it is not clear whether the patient satisfaction observed was
64 congruent with the change of intervention.
- 65 • Telehealth, in general, is a relatively new topic in medicine (since 1990s) so inferences
66 that result from studies are difficult to compare to older, more traditional interventions.

68 **Introduction**

69 **Rationale**

70 The mental image of medical house calls is one of archaic practices in small towns and
71 otherwise rural communities, or something associated with concierge medicine. However,
72 telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to
73 more technological-delivered services, making it possible to receive healthcare services from the

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3 74 comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot
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5 75 before one's appointment. This review examines telehealth and any association it might have
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8 76 with patient satisfaction.
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10 77 This review uses the definition of telehealth from the World Health Organization:

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12 78 The delivery of health care services, where distance is a critical factor, by all health care
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14 79 professionals using information and communication technologies, for the exchange of
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16 80 valid information for diagnosis, treatment, and prevention of disease and injuries,
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18 81 research and evaluation, and for the continuing education of health care providers, in all
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20 82 the interests of advancing the health of individuals and their communities.¹
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24 83 Following the WHO's example, we did not distinguish between telehealth and telemedicine;
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26 84 instead we used the term telehealth to address both telehealth and telemedicine.¹ This broad
27
28 85 definition of telehealth encompasses several modes of delivery, such as videoconferencing,
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30 86 mobile applications, and secure messaging. The WHO recognizes several branches of
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32 87 telemedicine: teleradiology, teledermatology, telepathology, and telepsychology.¹ With the
33
34 88 increase use of technology in healthcare, there has been a great emphasis on telehealth because it
35
36 89 can extend the services of providers to remote locations and capitalize on the availability of
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38 90 subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it
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40 91 has the potential of making healthcare services more convenient for patients, especially those in
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42 92 rural areas, those with small children (child care), and those with mobility restrictions.^{2,3}
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48 93 Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of
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50 94 the customer, it is a measure of quality that is published in the US through its Healthcare
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52 95 Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the
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54 96 Center for Medicare and Medicaid through results of Hospital Consumer Assessment of
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3 97 Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare
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5 98 delivery, telehealth relies heavily on reports of patient satisfaction because the patients are the
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8 99 only source of information that can report how they were treated and if the treatment received
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10 100 met the patients' expectations of care.^{4,5} If the patients are not happy with their healthcare
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12 101 services being provided remotely, the service becomes redundant and expensive. With the
13
14 102 increase in prevalence of telehealth, it is important to maintain the key quality indicator of
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16 103 patient satisfaction regardless of modality of delivery. The voice of the customer needs to be
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18 104 continuously heard so that telehealth developers can exercise agility in the development process
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20 105 while the healthcare organization continues to develop more technology-based care that meets
21
22 106 the needs of patients and providers. The technology base inherent to telehealth dramatically
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24 107 changes the mode of delivery, but a strong patient-to-provider relationship must be maintained
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26 108 independent of the modality. A definition of patient satisfaction, effectiveness, and efficiency are
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28 109 provided at the end of the manuscript.
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34 110 **Objective**

35 111 We had multiple research questions. R1: Is there an association of telehealth with patient
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37 112 satisfaction? R2: Are there common facilitators of either efficiency or effectiveness mentioned in
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39 113 the literature that would provide a positive or negative association between telehealth and patient
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41 114 satisfaction?
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46 115 **Methods**

47 116 48 117 *Information sources, search, and study selection*

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50 118 The two sources of data were the Cumulative Index of Nursing and Allied Health
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52 119 Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE). We used the Preferred
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3 120 Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) as our basis of
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5 121 organization.⁶
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8 122 We used a variety of key search terms, as listed in the Medical Subject Headings (MeSH)
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10 123 combined with Boolean operators. Search terms were adapted for use in the different databases.
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12 124 Details for each database are provided as supplemental data.
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15 125 Inclusion criteria were: 2010 through 2017, English only, full text available, and human research.
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17 126 We also filtered for all but academic publications (peer-reviewed in CINAHL) and in CINAHL
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19 127 we excluded Medline to eliminate the duplicates already captured in PubMed. Instead of
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21 128 including reviews in the analysis, two reviews on a similar topic were earmarked for later
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23 129 comparison with our own results. Abstracts were reviewed for suitability based on our research
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25 130 concept that included both telehealth and some assessment of patient satisfaction.
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28 29 131 *Data collection process* 30

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32 132 Before reviewing abstracts for suitability to our objective, we agreed on the qualities of
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34 133 telehealth and patient satisfaction to look for from our initial research. Articles were assessed
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36 134 according to the inclusion and exclusion criteria described above, and data were extracted
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38 135 according to pre-defined themes. Discussion sessions and consensus meetings were held to
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40 136 increase the inter-rater reliability of the group as they conducted the screening and analysis.
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42 137 During the consensus meetings factors and themes were identified.
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46 138 Standard systematic review procedures were followed to control for selection bias and
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48 139 ensure our search was exhaustive.
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51 140 Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a
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53 141 literature matrix. Another consensus meeting was conducted to discuss findings and make
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55 142 inferences. During the consensus meeting, individual observations were discussed and combined
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3 143 into similar groupings throughout the sample to simplify our assessment of associations. This is a
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5 144 form of narrative analysis and sensemaking.⁷ Observations of effectiveness and efficiency were
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8 145 combined and sorted into an affinity matrix for final analysis.
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10 146 *Data items and summary measures*

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13 147 Our litmus test was to include articles that included a combination of telehealth and
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15 148 patient satisfaction, and a measure or assessment of effectiveness or efficiency. We eliminated
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17 149 those that fell short of those goals.
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19 150 *Risk of bias in individual studies and risk of bias across studies*

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22 151 Bias was discussed during consensus meetings. The consensus meetings served as a
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24 152 control on our own selection bias and selective reporting within studies.
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26 153 *Summary measures and synthesis of results*

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29 154 Our review examines articles that combine telehealth intervention with patient
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31 155 satisfaction and include some mention of effectiveness or efficiency. A physical count of these
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33 156 observations was made. After all observations were combined into an Excel file, and after all
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35 157 observations were condensed into themes of effectiveness or efficiency, all themes were
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37 158 displayed in an affinity matrix to identify the number of occurrences of each theme. These were
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39 159 sorted by frequency.
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44 160 **Results**

45 161 **Study Selection, Study Characteristics and Results of Individual Studies**

46 162 Our search process is illustrated in Figure 1.

47 163 Figure 1: Literature Search process with inclusion and exclusion criteria

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51 165 After the initial search yielded 2193 results, 193 underwent abstract and then full-text review
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55 166 resulting in 44 papers being included in the study
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3 167 Table 1 lists a summary of our analysis and observations from our team (n=44). For every
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5 168 article/study in the sample, we made observations for *satisfied*, which was a screening criteria,
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8 169 and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the
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11 170 top. The reference numbers correspond to those in the references section.

12
13 171 **Table 1: Compilation of observations for our sample**

Author	Summary/Conclusion	Comments and Observations of Bias
Schulz-Heik, et al. ⁸	Clinical yoga with U.S. Veterans Affairs population Satisfaction: Participants' satisfaction did not differ from the control group Effectiveness: Participants' 16 specific health outcomes did not differ from the control group	VA population in Palo Alto only (geographically limited)
Iqbal A, et al. ⁹	Ileostomy patients at University of Florida provided with an education and management protocol plus a daily telephone call for 3 weeks after discharge (n=38). Satisfaction reported 4.69 (1-5 scale). Effective: Readmission rates decreased from 65% to 16% from the control group saving \$63,821	Satisfactory sample size Limited to one area of the country and beneficiaries to one university health system (geographically limited)
Muller KI, et al. ¹⁰	Using telehealth to diagnose and treat nonacute headaches (n=200) Satisfaction: Patients satisfied with video and sound quality. Intervention group's consultations shorter than control group. Efficient: Median travel distance for rural pts was 7.8 hours, cost €249, lost income €234 per visit (saved).	Nonacute headache patients from Northern Norway strong sample size patients randomized
Dias AE, et al. ¹¹	Voice rehabilitation in Parkinson's Disease (n=20) Satisfaction: Reported as high Effective: Preference for telehealth intervention	(small sample size)

1 2 3 4 5 6 7 8 9 10 11 12	Langabeer JR, et al. ¹²	Telehealth enabled EMS services program to reduce transport of lower acuity pts to ED in Houston (n=5,570). Satisfaction: No decrease Efficient: 56% reduction in ambulance transports and 53% decrease in response time for the intervention group than the control. No difference in patient satisfaction.	Strong sample size Limited to pts regional to Houston, Texas) (no randomization, geographically limited)
13 14 15 16 17 18 19 20 21 22 23 24	Hoas H, et al. ¹³	Adherence and factors affecting satisfaction in long-term relerehabilitation for patients with chronic COPD in Norway (n=10). Satisfaction: Telemonitoring and self-management combined with weekly videoconferencing with physiotherapist. Effective: Increased health benefits, self-efficacy, independence, emotional safety, and maintenance of motivation	Study spans 2 years (small sample size)
25 26 27 28 29 30 31 32 33	Jacobs JJ, et al. ¹⁴	Patient satisfaction with teleradiology service in general practice in Netherlands Satisfaction: Island residents, the elderly, and those with no history of trauma were more satisfied with the technical and interpersonal aspects of the teleconsultation than non-residents, younger patients, and those with history of trauma.	rural health (geographically limited)
34 35 36 37 38 39 40 41	Bradbury A, et al. ¹⁵	Utilizing remote real-time videoconferencing to expand access to cancer genetic services in community practices (n=41) Satisfaction: All patients reported satisfaction and knowledge increased significantly. Effective: General anxiety and depression decreased	University of Pennsylvania, Philadelphia (limited population)
42 43 44 45 46 47 48 49	Alazab R, & Khader Y. ¹⁶	Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life (n=64) Satisfaction: Patient satisfaction mean = 96.8 Effective: Mean SF8 score increased significantly (physical components of quality of life)	rural health (geographically limited)
50 51 52 53 54 55 56 57 58 59 60	Fields BG, et al. ¹⁷	Remote ambulatory management of veterans with obstructive sleep apnea (n=60)	Veterans in the Philadelphia area only

	<p>Satisfaction: No difference in functional outcomes, patient satisfaction, dropout rates, or objectively measured PAP adherence.</p> <p>Effective: Telemedicine participants showed greater improvement in mental health scores and their feedback was positive.</p>	(geographically limited)
Georgsson M, & Stagers N. ¹⁸	<p>Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with association user characteristics in the US and Sweden (n=10)</p> <p>Satisfaction: good</p> <p>Effective: Good but not excellent usability</p> <p>Males were more successful in task completion, and younger participants had higher performance scores.</p> <p>Level of education had no effect, but recency of diagnosis of diabetes did. Patients with more experience with IT also had higher performance scores.</p>	(small sample size) (technology bias)
Polinski JM, et al. ¹⁹	<p>Patients' satisfaction with and preference for telehealth visits (n=1734)</p> <p>Satisfaction: 33% preferred telehealth visits to traditional in-person visits. Women preferred telehealth visits.</p> <p>Efficient: Telehealth increased access to care. Lack of insurance increased odds of preferring telehealth.</p> <p>Efficient: Other positive predictors were quality of care received, telehealth convenience, understanding of telehealth</p>	70% women (gender bias)
Levy EL, et al. ²⁰	<p>Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes.</p> <p>Satisfied: all but one participant reported satisfied or highly-satisfied</p> <p>Effective: participants demonstrated significant improvement in most outcomes measures</p> <p>Efficient: participants avoided 2,774.7 +/- 3,197.4 travel miles, 46.3 +/- 53.3 hours of driving time, and \$1,151.50 +/- \$1,326.90 in travel reimbursement</p>	<p>Veterans only, convenience sample (limited population)</p> <p>Participants were 92.3% male and 69.2% 64 years old or less (gender and age bias)</p>
Holmes M, Clark S. ²¹	<p>Technology-enabled care services: novel method of managing liver disease (n=12).</p> <p>Satisfied: high, patients liked the self-manage aspect</p> <p>Effective: Participants lost weight, outcomes improved, readmissions decreased from 12 to 4</p>	(Small sample size)

	Efficient: Average cost per patient 68.86 British pounds	
Levy N, et al. ²²	The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. Highly satisfied: Patients in the intervention group reported higher levels of satisfaction Effective: Significantly more in the intervention group had reached their optimal insulin levels	True experiment (randomized, good sampling technique)
Moin T, et al. ²³	Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. Satisfied: Participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle Effective: Improved behavioral outcomes, more appropriate for women	Women veterans, Computer literacy was an issue for some (gender bias, small sample size)
Cotrell C, et al. ²⁴	Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. Satisfied: Positive patient satisfaction indicators Effective: Improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered	satisfaction with AIM appeared optimal when patients were carefully selected (Selection bias)
Tabak M, et al. ²⁵	A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial (n=19). Satisfied: Satisfaction was higher with the control group than the telehealth group Effective: Better clinical measures in the telehealth group	Strong study design (Small sample size)
Kim H, et al. ²⁶	Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets (n=20 visits for 45 patients). Satisfied: Easy to use, very convenient Effective: Outcomes similar to in-clinic visits Efficient: Cost \$916.64 per patient	Good analysis of fixed versus variable costs.

1 2 3 4 5 6 7 8 9 10 11 12 13 14	Cancela J, et al. ²⁷	Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors (n=32). Satisfied: Overall satisfaction high, but some concern over public perceptions about the wearable sensors Effective: For remote monitoring, wearable systems are highly effective	An extension of the Body Area Network (BAN) sensors (limited population)
15 16 17 18 19 20 21 22	Casey M, et al. ²⁸	Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care (n=12). Satisfied: Good usability Effective: Transformed relationships with exercise	(Small sample size)
23 24 25 26 27	Tsai CH, et al. ²⁹	Influences of satisfaction with telecare and family trust in older Taiwanese people (n=60). Satisfied: User satisfaction very high Effective: User perception of high quality	Focus was on older users and their families. (age bias)
28 29 30 31 32 33 34 35 36 37 38	Oliveira TC, et al. ³⁰	Telemedicine in Alentejo Satisfied: Positive impact on patient experience Efficient: Average time and cost of a tele-appointment is 93 minutes for teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face	Participants are older and less educated than the rest of the population of Portugal. (age and education bias)
39 40 41 42 43 44 45 46 47 48 49 50	Minatodani, et al. ³¹	Home telehealth: Facilitators, barriers, and impact of nurse support among high-risk dialysis patients. Satisfaction: Patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes Effective: Through telehealth, greater self-awareness, self-efficacy, and accountability Efficient: Feedback was more efficient	(Limited population)
51 52 53 54 55 56 57 58 59 60	Akter S, et al. ³²	Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. Satisfied: satisfaction is related to service quality, continuance intentions, and quality of life Effective: mHealth should deliver higher-order, societal outcomes	(Selection bias)

<p>Hung Y, et al.³³</p>	<p>Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care.</p> <p>Satisfied: Higher use was indicative of higher satisfaction</p> <p>Effective: Higher use was clinically important to outcomes</p>	<p>(Small sample size)</p>
<p>Buis LR, et al.³⁴</p>	<p>Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy (n=159).</p> <p>Satisfied: 67.1% reported very high satisfaction</p> <p>Effective: txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise</p> <p>Efficient: Low participant costs</p>	<p>Michigan and Cincinnati only (geographically limited)</p>
<p>Houser SH, et al.³⁵</p>	<p>Telephone follow-up in primary care: can interactive voice response calls work (n=19)?</p> <p>Satisfied: Strong satisfaction reported for the interactive voice response system, IVRS</p> <p>Effective: Patients felt informed</p>	<p>Small sample of those who received the call IVRS (small sample size)</p>
<p>Kairy D, et al.³⁶</p>	<p>The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty (n=5).</p> <p>Satisfied: Feeling an ongoing sense of support</p> <p>Effective: Tailored challenging programs using telerehabilitation</p> <p>Efficient: Improved access to services with reduced need for transportation, easy to use</p>	<p>Convenience sample. Single case. (small sample size)</p> <p>Retrospective -- asked participants to reflect on the last 8 weeks of treatment</p>
<p>Bishop TF, et al.³⁷</p>	<p>Electronic communication improves access, but barriers to its widespread adoption remain.</p> <p>Satisfied: Easier access to and better communication with provider</p> <p>Effective: Patients with repeat issues of a condition are able to reset the treatment for the most recent episode</p> <p>Efficient: It takes about one minute per email, and it improves the efficiency of an office visit</p>	<p>New York City only. Heavy resistance to change cited. (geographically limited)</p> <p>Some providers are not technology saavy.</p> <p>The additional workload can take a psychological toll on providers because the work never stops.</p>

Pietta JD, et al. ³⁸	<p>Satisfied: 88% patients reported "very satisfied", 11% "mostly satisfied"</p> <p>Effective: 100% patients felt the interactive voice response: IVR were helpful, 77% reported improved diet, 80% reported improved symptom monitoring, 80% reported improved medication adherence</p>	<p>73% women, average 6.1 years of education (age and education bias)</p>
Gund A, et al. ³⁹	<p>A randomized controlled study about the use of eHealth in the home health care of premature infants (n=13, 12, 9). Three groups were compared.</p> <p>Satisfied: parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit</p> <p>Effective: Same or better outcomes because the parents did not have to bring infants in</p> <p>Efficient: Nurses took less than 10 minutes of work time daily to answer questions</p>	<p>Randomization used. Semi-structured interviews were only used for 16 families.</p>
ter Huurne ED, et al. ⁴⁰	<p>Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study (n=89).</p> <p>Satisfied: High satisfaction</p> <p>Effective: Significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only</p>	<p>Not all participants reported the same diagnoses. Strong pre-post design.</p>
Chun, YJ & Patterson PE. ⁴¹	<p>A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system (n=16).</p> <p>Satisfied: on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system</p> <p>Efficient: task completion rate was 80% for younger group and 64.6% for older group</p>	<p>(Small sample size)</p>
Lee AC, et al. ⁴²	<p>The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation.</p> <p>Satisfied: reported as high and very high</p> <p>Effective: Increases access where proximity is an issue</p> <p>Efficient: Links multiple providers together for teleconsultation</p>	<p>limited scope for conclusions</p>

<p>1 2 3 4 5 6 7 8 9 10 11 12 13</p> <p>Saifu HN, et al.⁴³</p>	<p>Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics (c=43). Satisfied: 95% reported highest level of satisfaction</p> <p>Effective: 95% reported a preference for telemedicine versus in-person visit Efficient: reported a significant reduction in health visit-related time, mostly due to decreased travel</p>	<p>Veterans in Los Angeles CA only Convenience sample (geographically limited)</p>
<p>14 15 16 17 18 19 20 21 22 23 24 25 26</p> <p>Lua PL, & Neni WS.⁴⁴</p>	<p>Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia (n=51). Satisfied: 74% reported very or quite useful</p> <p>Effective: Excellent modality for education, drug-taking reminder, and clinic appointment reminder</p>	<p>Good mix of genders, homo-ethnic sample: 92.2% Malay (racial bias) median age 25 (age and technology bias – younger may already be more receptive to technology)</p>
<p>27 28 29 30 31 32 33 34 35</p> <p>Finkelstein, et al.⁴⁵</p>	<p>Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. Satisfied: Ninety percent of the subjects were satisfied with the home health telehealth service Effective: Frequency of communication increased</p>	<p>(Limited population)</p>
<p>36 37 38 39 40 41 42 43 44</p> <p>Gibson KL, et al.⁴⁶</p>	<p>Conversations on telemental health: listening to remote and rural First Nations communities. Satisfied: 47% positive response, 21% neutral, 32% negative Effective: Increased comfort in the therapeutic situation, increased usefulness Efficient: Increased access to services</p>	<p>First-nations communities only (limited population)</p>
<p>45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60</p> <p>Doorenbos, et al.⁴⁷</p>	<p>Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities (n=32). Satisfied: Participants reported high levels of satisfaction with support groups via videoconference Effective: Results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors</p>	<p>All participants were women. (Gender bias) Rural care focus participants were members of American Indian or Alaskan Native (Limited population)</p>

Breen P, et al. ⁴⁸	<p>Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part II: the referring clinician and patient perspective.</p> <p>Satisfied: Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management (n=9 physicians, 116 patients).</p> <p>Effective: Telephysiology and control groups were equally as anxious about their procedure, telephysiology can improve access to CN services and expert opinion</p> <p>Efficient: Reduced travel burden and need for overnight journeys</p>	<p>Both patients and clinicians expressed satisfaction with telephysiology</p> <p>(Small sample of physicians)</p>
Everett J & Kerr D. ⁴⁹	<p>Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study.</p> <p>Satisfied: Patients reported more understanding, insight, and control by viewing data and easy access to health professional</p> <p>Effective: Intervention group demonstrated improved diabetes control</p> <p>Efficient: Health professional time was less than 10 minutes each day to review data and was incorporated into current workload</p>	<p>Each user's home was visited to set up and demonstrate the system. (good control for validity)</p>
Gardner-Bonneau D. ⁵⁰	<p>Remote Patient Monitoring: A Human Factors Assessment (n=27 control, n=19 intervention).</p> <p>Satisfied: The intervention device was intuitive to use</p> <p>Effective: Telehealth group showed clinical improvements</p> <p>Efficient: Economic analysis showed savings in the COPD telemonitoring group, software issues caused many interventions by medical staff which consumed time</p>	<p>Medical literacy became an issue when the device asked patients if their readings were normal.</p> <p>(Small sample size)</p>
Shein RM, et al. ⁵¹	<p>Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating.</p> <p>Satisfied: Higher satisfaction with telerehabilitation</p> <p>Efficient: Great time savings in travel</p>	<p>(Racial and age bias)</p> <p>89.6% Caucasian, average age was 55</p>

Synthesis of Results

We analyzed the way 44 articles reported patient satisfaction.⁸⁻⁵¹ Twenty-four^{8,9,11,13,15-18,21-25,27-29,32,33,35,38,40,44,45,47} studies reported patient views on effectiveness, six^{10,12,14,30,41,51} studies reported patient satisfaction and fourteen^{19,20,26,31,34,36,37,39,42,43,46,48,49,50} studies reported

177 both. The third column lists comments and details that could point to selection bias. Potential
 178 risk of bias among papers included: no randomization,¹² small sample
 179 size,^{11,13,18,21,23,25,28,33,35,36,41,48,50} limited population,^{15,20,27,29,31,45-47} gender bias,^{19,20,23,38,47}
 180 technology bias,^{18,23,44,50} selection bias,^{24,32,38} geographically limited,^{8,9,12,14,16,17,34,37,43} age
 181 bias,^{20,29,30,38,44,51} education bias,^{30,38} and racial bias.^{44,51}

182 Additional Analysis

183 Table 2 is the result of the additional analysis listed in the Methods section. Through a
 184 narrative analysis we identified commonalities among the various studies (19 factors) and
 185 compiled them into an affinity matrix to show frequency of occurrence. The matrix is sorted by
 186 frequency of occurrence. These 19 factors of effectiveness/efficiency occurred 119 times in the
 187 literature.

188 **Table 2: Affinity matrix**

Factor	Article reference number	Frequency
Improved outcomes	8,9,11,13,15-17,18,20-26,31-33,38-41,47,50	24
Preferred modality	8,9,11,14,15,19,22,26,34,43,44,46	12
Ease of use	18,19,23,26,28,36-38,46,49,50	11
low cost, or cost savings	10,14,16,20,21,23,26,34,50	9
Improved communication	24,27,31,36,37,39,42,45,49	9
Travel time	10,12,20,30,36,43,48,51	8
Improved self-management	13,21,23,28,31,32,48	7
Quality	16,19,29,32,40	5
Increased access	19,42,46,48	4
Increased self-awareness	31,34,35,38	4
Decreased wait times	16,43,48,49	4
Fewer miles driven	10,14,20,51	4
Decreased in-person visits	12,39,43	3
Improved self-efficacy	13,23,31	3
Good modality for education	15,34,44	3
Low time to manage	37,39,49	3
Improved medication adherence	13,38,44	3
Decreased readmissions	9,21	2

Fewer missed appointments	44	1
		119

189

190 We acknowledge that frequency of occurrence does not equate to importance, but it has

191 been used in other literature reviews as simply an issue of probability.⁵²⁻⁵⁴ Five factors were

192 mentioned in the literature 65/119 occurrences (55%): *improved outcomes*,^{8,9,11,13,15-17,18,20-26,31-}

193 ^{33,38-41,47,50} *preferred modality*,^{8,9,11,14,15,19,22,26,34,43,44,46} *ease of use*,^{18,19,23,26,28,36-38,46,49,50} *low cost*

194 or *cost savings*,^{10,14,16,20,21,23,26,34,50} and *improved communication*.^{24,27,31,36,37,39,42,45,49}

195 Discussion

196 Summary of Evidence

197 Telehealth has the potential to extend the boundaries of providers' practices by

198 overcoming the barrier of proximity. Along with the introduction of a new modality of care

199 comes change, and the literature mentioned various reactions to this change. One study identified

200 heavy resistance to change,^{29,37} while others mentioned an embrace of the change.^{29,48} Older

201 patients, in general, do not embrace change, but recent studies have identified a generational

202 acceptance of technology and mHealth in general.⁵⁵

203 Our findings from this systematic review and narrative analysis identify some issues that

204 are salient in the literature. To help overcome provider resistance to change to telehealth, it

205 should be noted that over the last seven years, 20% of the factors of effectiveness in the literature

206 were improved outcomes. Providers and patients should embrace telehealth modalities because

207 of its ease of use,^{18,19,23,26,28,36-38,46,49,50} its tendency to improve outcomes^{8,9,11,13,15-17,18,20-26,31-33,38-}

208 ^{41,47,50} and communication,^{24,27,31,36,37,39,42,45,49} and its low cost.^{10,14,16,20,21,23,26,34,50} It can decrease

209 travel time^{10,12,20,30,36,43,48,51} and increase communication with providers. Telehealth can provide a

210 high quality service, increase access to care,^{19,42,46,48} increase self-awareness,^{31,34,35,38} and

1
2
3 211 itempowers patients tomanage their chronic conditions.^{13,21,23,28,31,32,48} Healthcare organizations
4
5 212 should embrace telehealth because it decreases missed appointments,⁴⁴ it is a good modality for
6
7 213 education,^{15,34,44} it decreases wait times,^{16,43,48,49} decreases readmissions,^{9,21} and improves
8
9 214 medication adherence.^{13,38,44} But most importantly, policy makers need to help legislation catch
10
11 215 up with the technology by enabling additional means of reimbursement for telehealth because the
12
13 216 modality improves outcomes,^{8,9,11,13,15-17,18,20-26,31-33,38-41,47,50} which improves public health.

17 18 217 **Comparison**

19 218 The results of our review and narrative analysis are consistent with other reviews. Health
20
21 219 outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple
22
23 220 studies,⁵⁶ Improvements have been identified for both physical and behavioral conditions. The
24
25 221 review by de Jong et al., did not identify a significant decrease in utilization.⁵⁶ This review also
26
27 222 focused on interventions that used asynchronous communication, like email and text messages,
28
29 223 with an older population. Our study included both asynchronous and synchronous interventions
30
31 224 with all ages.

32
33 225 We were able to locate a study from 2011 that also evaluated telehealth and patient
34
35 226 satisfaction.⁵⁷ The researchers used secondary data analysis as the basis for their study. Their
36
37 227 study focused on patient satisfaction and home telehealth in US Veterans. Similar to the de Jong
38
39 228 review, this study focused on an older population ranging from 55-87, while our analysis
40
41 229 included younger age groups. Its focus on US Veterans while ours included this group as only
42
43 230 part of our population. Our approach can equate to a greater external validity to our analysis. The
44
45 231 Young et al. review found that its participants were extremely satisfied with the care
46
47 232 coordination/home telehealth (CCHT) program. The US Veterans in this review embraced the
48
49 233 new modality. The researchers found a decrease in utilization associated with the telehealth
50
51 234 modality.

235 **Limitations**

236 We identified several limitations in the conduct of our literature review and narrative
237 analysis. Selection bias is possible within this study, however our group-consensus
238 methods will have mitigated against this risk. Publication bias is another risk, particularly as we
239 did not extend our search to the grey literature. Limiting our search to only two databases could
240 easily have omitted valid articles for our review. We controlled for inter-rater reliability through
241 the initial focus study of the topic followed by several consensus meetings held along the
242 iterative process. By continuing to review our findings, we follow the example of other reviews
243 and narrative analyses.⁵²⁻⁵⁵

244 The final limitation that we identified was the young age of the telehealth modality of
245 care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young.
246 Because it is technologically based, we chose to only look at the last five years, which could also
247 limit our findings, but the rapid advancement of a technologically-based modality drives a more
248 recent sample to make current observations and conclusions.

249 **Conclusions**

250 Overall, it was found that patient satisfaction can be associated with the modality of
251 telehealth, but factors of effectiveness and efficiency are mixed. We found that patients'
252 expectations were met when providers delivered healthcare via videoconference or any other
253 telehealth method. Telehealth is a feasible option for providers who want to expand their
254 practices to remote areas without having to relocate or expand their footprint of their practice. As
255 telehealth continues to be developed, special care should be given to incorporate features that
256 enable acceptance and reimbursement of this modality.

257 **Basic definitions**

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2
3 258 *Patient satisfaction*: The U.S. Center for Medicare and Medicaid Services defines this term as
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5
6 259 the patient's perspective of care which can be objective and meaningful to create comparisons of
7
8 260 hospitals and other healthcare organizations.⁵⁸

9
10 261 *Effective*: successful or achieving the results that you want.⁵⁹ Usually associated with outcomes.

11
12 262 *Efficient*: performing or functioning in the best possible manner with the least waste of time and
13
14
15 263 effort; having and using requisite knowledge, skill, and industry.⁶⁰

16
17
18 264 **Data sharing statement**

19
20 265 All data are freely available

21
22 266 **List of abbreviations**

23
24 267 AIM: Advice and interactive messaging system

25
26 268 BAN: Body area network

27
28 269 CCHT: Care coordination/home telehealth

29
30 270 CINAHL: Cumulative index of nursing and allied health literature

31
32 271 CVT: Clinical Video Teleconferencing

33
34 272 EBSCO Host: Elton B Stephens Company

35
36 273 HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems

37
38 274 HEDIS: Healthcare Effectiveness Data and Information Set

39
40 275 IVRS: Interactive voice response system

41
42 276 MEDLINE: U.S. National Library of Medicine bibliographic database

43
44 277 MeSH: Medical subject headings from the U.S. Library of Medicine

45
46 278 PPACA: Patient Protection and Affordable Care Act

47
48 279 WHO: World Health Organization

49
50 280 **Acknowledgements**

1
2
3 281 We would like to acknowledge Texas State University for using their library database for our
4
5 282 research.

6
7
8 283 **Ethics approval and consent to participate:** Not applicable

9
10 284 No humans or animals were involved in this study; therefore this study is categorized as IRB
11
12 285 Exempt in 45CFR46.

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14
15 286 **Consent for publication:** Not applicable

16
17 287 **Availability of data and materials:** Not applicable

18
19
20 288 All data and materials used in the creation of this manuscript are included in the appendices

21
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23
24 290 **Funding:** Not applicable. There was no funding in the creation of this review.

25
26
27 291 **Authors' contributions**

28
29 292 The contributions of the six-member team meet the requirements for authorship. CK directed the
30
31 293 initial research, served as lead author, mediated discussions about the merit of abstracts/articles,
32
33 294 integrated the input from all team members, and helped refine the figure and tables to provide
34
35 295 continuity and flow. NK contributed the initial draft of the introduction, and integrated her
36
37 296 viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR
38
39 297 contributed the initial draft of the abstract, and she integrated her viewpoints into the methods,
40
41 298 discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the
42
43 299 initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the
44
45 300 initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB
46
47 301 served as an expert in research in U.S. Veterans due to his research in this area, and he
48
49 302 contributed meaningful contribution to the formation of analysis and conclusion.

50
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304 **FIGURE LEGEND**
305 **Figure 1: Literature Search process with inclusion and exclusion criteria**
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For peer review only

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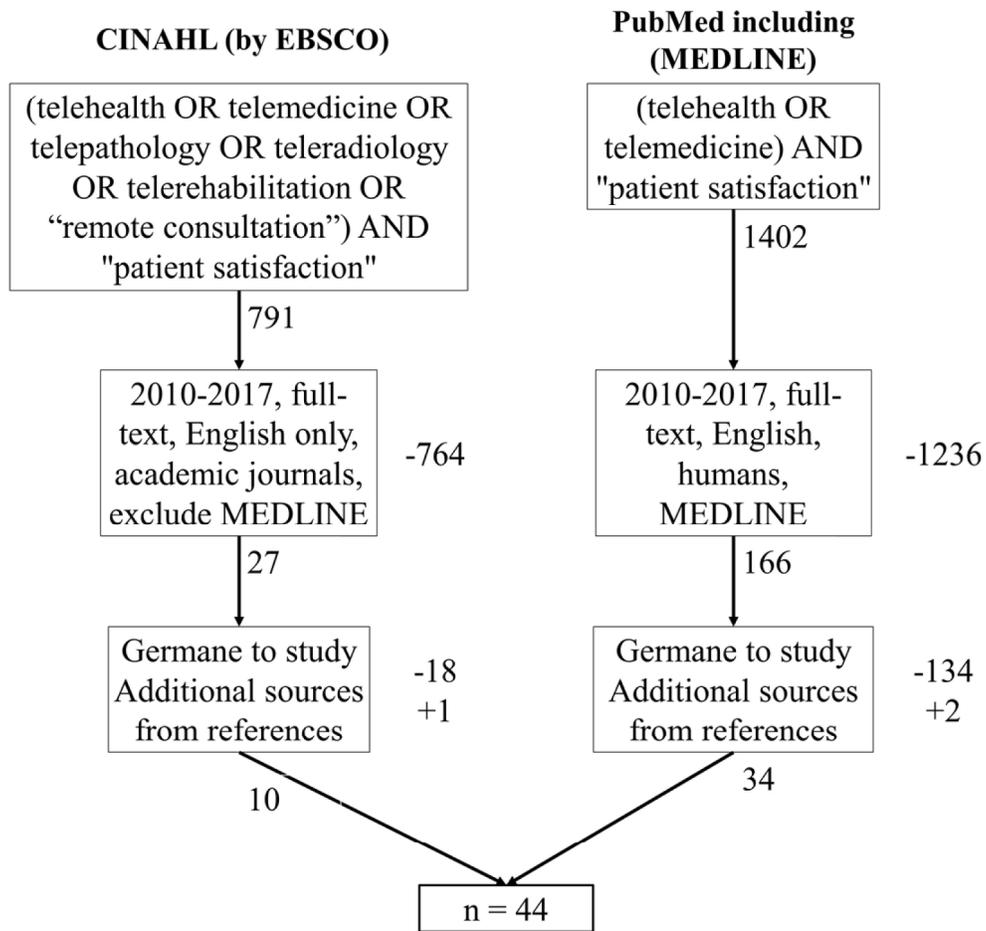
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Literature Search process with inclusion and exclusion criteria

246x236mm (300 x 300 DPI)

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3 1 Supplemental data
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6 2 Search terms
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10 3 Search strings for the two research databases differed because of the differences in the
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12 4 indexing methods used by each database. PubMed indexes the following under the heading of
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14 5 telemedicine: telerehabilitation, teleradiology, telepathology, and remote consultation. CINAHL
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16 6 does not automatically index these terms together so they were searched for by name. The initial
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18 7 search in PubMed was (telemedicine OR telehealth) AND "Patient Satisfaction."
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PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2 for each meta-analysis).	



PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Page 2 of 2

For peer review only - <http://bmjopen.bmj.com/site/about/guidelines.xhtml>

BMJ Open

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016242.R3
Article Type:	Research
Date Submitted by the Author:	23-Jun-2017
Complete List of Authors:	Kruse, Clemens; Texas State University, School of Health Administration Krowski, Nicole; Texas State University, School of Health Administration Rodriguez, Blanca; Texas State University, School of Health Administration Tran, Lan; Texas State University, School of Health Administration Vela, Jackeline; Texas State University, School of Health Administration Brooks, Matthew; Texas State University, School of Health Administration
Primary Subject Heading:	Patient-centred medicine
Secondary Subject Heading:	Qualitative research
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, patient satisfaction, telehealth

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Manuscripts

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3 1 **Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis**
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6 2 Running title: **Telehealth and Patient Satisfaction**
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3 **30 Abstract**
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5 **31** *Background:* The use of telehealth steadily increases as it has become a viable modality to
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8 **32** patient care. Early adopters attempt to use telehealth to deliver high quality care. Patient
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10 **33** satisfaction is a key indicator of how well the telemedicine modality met patient expectations.
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12 **34** *Objective:* The objective of this systematic review and narrative analysis is to explore the
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15 **35** association of telehealth and patient satisfaction in regards to effectiveness and efficiency.
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17 **36** *Methods:* Boolean expressions between key words created a complex search string. Variations of
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20 **37** this string were used in CINAHL and MEDLINE.
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22 **38** *Results:* 2193 articles were filtered and assessed for suitability (n=44). Factors relating to
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25 **39** effectiveness and efficiency were identified using consensus. The factors listed most often were
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27 **40** improved outcomes (20%), preferred modality (10%), ease of use (9%), low cost 8%), improved
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29 **41** communication (8%), and decreased travel time (7%); which in total accounted for 61% of
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32 **42** occurrences.
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34 **43** *Conclusion:* This review identified a variety of factors of association between telehealth and
35
36 **44** patient satisfaction. Knowledge of these factors could help implementers to match interventions
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39 **45** as solutions to specific problems.
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41 **46**
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43 **47** Key words: patient satisfaction; telehealth; telemedicine; quality; access; patient quality;
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46 **48** telecommunications; home telehealth.
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50 **Strengths and limitations of this study**

51 Strengths

- 52 • Inserting technology into a medical intervention should not be without deliberate design.
53 This review serves as a voice of the patient to help guard against the implementation of
54 technology merely for its convenience or shiny appeal.
- 55 • This study uses the PRISMA standard, which is an internationally recognized protocol
56 for the conduct and reporting of systematic reviews, which increases the validity of the
57 results.
- 58 • A group >30 selected from MeSH key terms indexed through established research
59 databases increases the reliability of the review

61 Limitations

- 62 • Published studies do not often clearly set out reasons for inserting technology into an
63 intervention, and therefore, it is not clear whether the patient satisfaction observed was
64 congruent with the change of intervention.
- 65 • Telehealth, in general, is a relatively new topic in medicine (since 1990s) so inferences
66 that result from studies are difficult to compare to older, more traditional interventions.

67 **Introduction**

68 **Rationale**

69 The mental image of medical house calls is one of archaic practices in small towns and
70 otherwise rural communities, or something associated with concierge medicine. However,
71 telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to
72 more technological-delivered services, making it possible to receive healthcare services from the
73 comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot

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3 74 before one's appointment. This review examines telehealth and any association it might have
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5 75 with patient satisfaction.
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8 76 This review uses the definition of telehealth from the World Health Organization:
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10 77 The delivery of health care services, where distance is a critical factor, by all health care
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12 78 professionals using information and communication technologies, for the exchange of
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14 79 valid information for diagnosis, treatment, and prevention of disease and injuries,
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16 80 research and evaluation, and for the continuing education of health care providers, in all
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18 81 the interests of advancing the health of individuals and their communities.¹
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22 82 Following the WHO's example, we did not distinguish between telehealth and telemedicine;
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24 83 instead we used the term telehealth to address both telehealth and telemedicine.¹ This broad
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26 84 definition of telehealth encompasses several modes of delivery, such as videoconferencing,
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28 85 mobile applications, and secure messaging. The WHO recognizes several branches of
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30 86 telemedicine: teleradiology, teledermatology, telepathology, and telepsychology.¹ With the
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32 87 increase use of technology in healthcare, there has been a great emphasis on telehealth because it
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34 88 can extend the services of providers to remote locations and capitalize on the availability of
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36 89 subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it
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38 90 has the potential of making healthcare services more convenient for patients, especially those in
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40 91 rural areas, those with small children (child care), and those with mobility restrictions.^{2,3}
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46 92 Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of
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48 93 the customer, it is a measure of quality that is published in the US through its Healthcare
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50 94 Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the
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52 95 Center for Medicare and Medicaid through results of Hospital Consumer Assessment of
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54 96 Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare
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3 97 delivery, telehealth relies heavily on reports of patient satisfaction because the patients are the
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5 98 only source of information that can report how they were treated and if the treatment received
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8 99 met the patients' expectations of care.^{4,5} If the patients are not happy with their healthcare
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10 100 services being provided remotely, the service becomes redundant and expensive. With the
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12 101 increase in prevalence of telehealth, it is important to maintain the key quality indicator of
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14 102 patient satisfaction regardless of modality of delivery. The voice of the customer needs to be
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16 103 continuously heard so that telehealth developers can exercise agility in the development process
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18 104 while the healthcare organization continues to develop more technology-based care that meets
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20 105 the needs of patients and providers. The technology base inherent to telehealth dramatically
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22 106 changes the mode of delivery, but a strong patient-to-provider relationship must be maintained
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24 107 independent of the modality. A definition of patient satisfaction, effectiveness, and efficiency are
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26 108 provided at the end of the manuscript.

32 109 **Objective**

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34 110 We had multiple research questions. R1: Is there an association of telehealth with patient
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36 111 satisfaction? R2: Are there common facilitators of either efficiency or effectiveness mentioned in
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38 112 the literature that would provide a positive or negative association between telehealth and patient
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40 113 satisfaction?

44 114 **Methods**

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48 116 *Information sources, search, and study selection*

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50 117 The two sources of data were the Cumulative Index of Nursing and Allied Health
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52 118 Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE). We used the Preferred
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54 119 Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) as our basis of
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56 120 organization.⁶ We used a variety of key search terms, as listed in the Medical Subject Headings
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3 121 (MeSH) combined with Boolean operators. Search terms were adapted for use in the different
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5 122 databases. Details for each database are provided as supplemental data.
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8 123 Inclusion criteria were: 2010 through 2017, English only, full text available, and human
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10 124 research. We also filtered for all but academic publications (peer-reviewed in CINAHL) and in
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12 125 CINAHL we excluded Medline to eliminate the duplicates already captured in PubMed. Instead
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14 126 of including reviews in the analysis, two reviews on a similar topic were earmarked for later
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16 127 comparison with our own results. Abstracts were reviewed for suitability based on our research
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18 128 concept that included both telehealth and some assessment of patient satisfaction.
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21 22 129 *Data collection process* 23

24 130 A flowchart of our data-collection process is located as supplemental material. Before
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26 131 reviewing abstracts for suitability to our objective, we agreed to look for articles that included
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28 132 telehealth and some measure of patient satisfaction. Articles were assessed according to the
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30 133 inclusion and exclusion criteria described above. Discussion sessions and consensus meetings
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32 134 were held to increase the inter-rater reliability of the group as they conducted the screening and
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34 135 analysis. During the consensus meetings factors and themes were identified through observation
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36 136 and discussion; e.g., as we discussed the articles, it became evident that patient satisfaction was
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38 137 often stated in terms of effectiveness and efficiency, so these became the themes.
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43 138 Standard systematic review procedures were followed to control for selection bias and
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45 139 ensure our search was exhaustive.
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48 140 Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a
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50 141 literature matrix. Another consensus meeting was conducted to discuss findings and make
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52 142 inferences. During the consensus meeting, individual observations were discussed and combined
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54 143 into similar groupings throughout the sample to simplify our assessment of associations. This is a
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3 144 form of narrative analysis and sensemaking.⁷ Observations of effectiveness and efficiency were
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5 145 combined and sorted into an affinity matrix for final analysis.
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8 146 *Data items and summary measures*

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10 147 Our litmus test was to include articles that included a combination of telehealth and
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12 148 patient satisfaction, and a measure or assessment of effectiveness or efficiency. We eliminated
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14 149 those that fell short of those goals.
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17 150 *Risk of bias in individual studies and risk of bias across studies*

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20 151 Bias was discussed during consensus meetings. The consensus meetings served as a
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22 152 control on our own selection bias and selective reporting within studies.
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25 153 *Summary measures and synthesis of results*

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27 154 Our review examines articles that combine telehealth intervention with patient
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29 155 satisfaction and include some mention of effectiveness or efficiency. A physical count of these
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31 156 observations was made. After all observations were combined into an Excel file, and after all
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33 157 observations were condensed into themes of effectiveness or efficiency, all themes were
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35 158 displayed in an affinity matrix to identify the number of occurrences of each theme. These were
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37 159 sorted by frequency.
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42 160 **Results**

43 161 **Study Selection, Study Characteristics and Results of Individual Studies**

44 162 Our search process is illustrated in Figure 1.
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48 163 Figure 1: Literature Search process with inclusion and exclusion criteria
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52 165 After the initial search yielded 2193 results, 193 underwent abstract and then full-text review
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54 166 resulting in 44 papers being included in the study
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3 167 Table 1 lists a summary of our analysis and observations from our team (n=44). For every
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6 168 article/study in the sample, we made observations for *satisfied*, which was a screening criteria,
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8 169 and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the
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11 170 top. The reference numbers correspond to those in the references section.

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13 171 **Table 1: Compilation of observations for our sample**
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Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
Apr-17	Schulz-Heik RJ, et al. ⁸	Results from a clinical yoga program for veterans via telehealth provides comparable satisfaction and health improvements to in-person yoga.	<i>BMC Complement Altern Med</i>	Clinical yoga with U.S. Veterans Affairs population	Videoconferencing	VA population in Palo Alto only (geographically limited), acceptable sample size (n=29 control, n=30 intervention)
Jan-16	Iqbal A, et al. ⁹	Cost effectiveness of a novel attempt to reduce readmission after ileostomy creation	<i>JSLS</i>	Patient satisfaction: Satisfaction scored 4.69 out of 5, Effective: hospital readmission rates decreased \$63,821 (71%) (<i>P</i> =.002).	Telephone call (daily) for 3 weeks after discharge	Limited to one area of the country and beneficiaries to University of Florida health system (geographically limited), good sample size (n=23 preintervention, n=32 postintervention)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
May-16	Muller KI, et al. ¹⁰	Acceptability, Feasibility, and Cost of Telemedicine for Nonacute Headaches: A randomized study comparing video and traditional consultations	<i>J Med Internet Res</i>	Used telehealth to diagnose and treat nonacute headaches. Satisfaction: Patients satisfied with video and sound quality. Efficient: Median travel distance for rural pts was 7.8 hours, cost €249, lost income €234 per visit (saved). Effective: Intervention group's consultations were shorter than control group	Videoconferencing	Nonacute headache patients from Northern Norway, strong sample size (n=200), participants randomized
Apr-16	Dias AE, et al. ¹¹	Voice telerehabilitation in Parkinson's disease	<i>Codas</i>	Satisfaction: Reported as high Effective: Preference for telehealth intervention	Videoconference and telephone	85% male (gender bias), videoconferencing mimicked the face-to-face rehabilitation for Parkinson's patients, small sample size (n=20)
Nov-16	Langabeer JR, et al. ¹²	Telehealth-enabled emergency medical services program reduces ambulance transport to urban emergency departments	<i>West J Emerg Med</i>	Satisfaction: No decrease Efficient: 56% reduction in ambulance transports and 53% decrease in response time for the intervention group than the control	Telephone	Limited to pts regional to Houston, Texas (geographically limited), no randomization, strong sample size (n=5,570)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2016	Hoas H, et al. ¹³	Adherence and factors affecting satisfaction in long-term telerehabilitation for patients with chronic obstructive pulmonary disease: a mixed methods study	<i>BMC Medical Informatics and Decision Making</i>	Satisfaction: Generally highly satisfied Effective: Increased health benefits, self-efficacy, independence, emotional safety, and maintenance of motivation	Webpage for daily telemonitoring and self-care and weekly follow-up videoconference consults with a physiotherapist	Remote population of northern Norway, small sample size (n=10)
2016	Jacobs JJWM, et al. ¹⁴	Patient satisfaction with a teleradiology service in general practice	<i>BMC Family Practice</i>	Satisfaction: Island residents, the elderly, and those with no history of trauma were more satisfied with the technical and interpersonal aspects of the teleconsultation than non-residents, younger patients, and those with history of trauma.	Teleradiology	Restricted to rural health and Netherlands (geographically limited), strong sample (n=381)
Feb-17	Bradbury A, et al. ¹⁵	Utilizing Remote Real-Time Videoconferencing to Expand Access to Cancer Genetic Services in Community Practices: A Multicenter	<i>Journal of Medical Internet Research</i>	Satisfaction: All patients reported satisfaction and knowledge increased significantly. Effective: General anxiety and depression decreased	Videoconferencing	Restricted to Philadelphia Pennsylvania (geographically limited), good sample size (n=41)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		Feasibility Study				
Jan-16	AlAzab R, & Khader Y. ¹⁶	Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life	<i>Rural and Remote Health</i>	Satisfaction: Patient satisfaction mean = 96.8 Effective: Mean SF8 score increased significantly (physical components of quality of life)	Electronic monitoring and telephone calls	Rural health (geographically limited), strong sample size (n=64)
Mar-16	Fields BG, et al. ¹⁷	Remote ambulatory management of veterans with obstructive sleep apnea	<i>Sleep</i>	Satisfaction: No difference in functional outcomes, patient satisfaction, dropout rates, or objectively measured PAP adherence. Effective: Telemedicine participants showed greater improvement in mental health scores and their feedback was positive	Telemonitoring and telephone follow-up calls	Restricted to veterans in the Philadelphia area (geographically limited), good sample size (n=60)

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Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
Jan-16	Georgsson M, & Staggers N. ¹⁸	Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with association user characteristics in the US and Sweden	<i>Journal of the American Medical Informatics Association</i>	Satisfaction: good Effective: Good but not excellent usability	mHealth application	Younger patients with more experience with information technology scored higher than others (age and technology bias), small sample size (n=10)
Mar-16	Polinski JM, et al. ¹⁹	Patients' satisfaction with and preference for telehealth visits	<i>Journal of general internal medicine</i>	Satisfaction: 33% preferred telehealth visits to traditional in-person visits. Women preferred telehealth visits. Efficient: Telehealth increased access to care. Lack of insurance increased odds of preferring telehealth. Efficient: Other positive predictors were quality of care received, telehealth convenience, understanding of telehealth	Videoconferencing at MinuteClinics with diagnostic tools operated by a nurse	70% women (gender bias), test was conducted in California and Texas (convenience sample), strong sample (n=1,734)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2015	Levy CE, et al. ²⁰	Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes	<i>Journal of rehabilitation research and development</i>	Satisfied: all but one participant reported satisfied or highly-satisfied Effective: participants demonstrated significant improvement in most outcomes measures Efficient: participants avoided 2,774.7 +/- 3,197.4 travel miles, 46.3 +/- 53.3 hours of driving time, and \$1,151.50 +/- \$1,326.90 in travel reimbursement	Videoconferencing	Convenience sample, 92% male (gender bias), 69% over 64 years old (age bias), U.S. veterans only, small sample (n=26)
2014	Holmes M, & Clark S. ²¹	Technology-enabled care services: novel method of managing liver disease	<i>Gastrointestinal Nursing</i>	Satisfied: high, patients liked the self-manage aspect Effective: Participants lost weight, outcomes improved, readmissions decreased from 12 to 4 Efficient: Average cost per patient 68.86 British pounds	Remote monitoring and text messaging	Small sample size (n=12)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2015	Levy N, et al. ²²	The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol	<i>JMIR research protocols</i>	Highly satisfied: Patients in the intervention group reported higher levels of satisfaction Effective: Significantly more in the intervention group had reached their optimal insulin levels	Mobile Insulin Titration Intervention	True experiment (randomized, good sampling technique)
2015	Moin T, et al. ²³	Women Veterans' Experience with a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice	<i>Journal of medical Internet research</i>	Effective: Improved behavioral outcomes, more appropriate for women Satisfied: Participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle	Web-based	Women veterans, computer literacy was an issue for some (gender bias), small sample size (n=17)
2015	Cotrell E, et al. ²⁴	Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation	<i>BMJ Open</i>	Satisfied: Positive patient satisfaction indicators Effective: Improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered	Telemonitoring and medication reminders	Satisfaction with the service appeared optimal when patients were carefully selected (selection bias), strong sample (n=1,707)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2014	Tabak M, et al. ²⁵	A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial	<i>International journal of chronic obstructive pulmonary disease</i>	Satisfied: Satisfaction was higher with the control group than the telehealth group Effective: Better clinical measures in the telehealth group	Web-based and smartphone application with an activity coach	Strong study design, small sample size (n=19)
2014	Kim H, et al. ²⁶	Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets	<i>Journal of Parenteral and Enteral Nutrition</i>	Satisfied: Easy to use, very convenient Effective: Outcomes similar to in-clinic visits Efficient: Cost \$916.64 per patient	Telephone with semi-structured interviews	Good sample size (n=20 visits for 45 patients)
2014	Cancela J, et al. ²⁷	Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors	<i>Sensors</i>	Satisfied: Overall satisfaction high, but some concern over public perceptions about the wearable sensors Effective: For remote monitoring, wearable systems are highly effective	Remote monitoring based on a body area network of sensors	An extension of the Body Area Network (BAN) sensors (limited population), good sample size (n=32)
2014	Casey M, et al. ²⁸	Patients' experiences of using a smartphone application to increase physical	<i>Br J Gen Pract</i>	Satisfied: Good usability Effective: Transformed relationships with exercise	Smartphone application	Small sample size (n=12)

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Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		activity: the SMART MOVE qualitative study in primary care				
Jan-14	Tsai CH, et al. ²⁹	Influences of satisfaction with telecare and family trust in older Taiwanese people	<i>International journal of environmental research and public health</i>	Satisfied: User satisfaction very high Effective: User perception of high quality	Telemonitoring, web-based, telephone	Focus was on older users and their families, convenience sample, good size (n=60)
2014	Oliveira TC, et al. ³⁰	Telemedicine in Alentejo	<i>Telemedicine and e-Health</i>	Satisfied: Positive impact on patient experience Efficient: Average time and cost of a tele-appointment is 93 minutes for teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face	Telephone	Participants are older and less educated than the rest of the population of Portugal (age and education bias)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2013	Minatodani DE, et al. ³¹	Home telehealth: Facilitators, barriers, and impact of nurse support among high-risk dialysis patients	<i>Telemedicine and e-Health</i>	Satisfaction: Patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes Effective: Through telehealth, greater self-awareness, self-efficacy, and accountability Efficient: Feedback was more efficient	Telemonitoring with nurse support	Limited population, good sample size (n=33)
2013	Akter S, et al. ³²	Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life	<i>Behaviour & Information Technology</i>	Satisfied: satisfaction is related to service quality, continuance intentions, and quality of life Effective: mHealth should deliver higher-order, societal outcomes	Smartphone application	Selection bias
2014	Hung YC, et al. ³³	Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell	<i>Journal of Human Nutrition and Dietetics</i>	Satisfied: Higher use was indicative of higher satisfaction Effective: Higher use was clinically important to outcomes	Telephone	Small sample size (n=18)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		transplantation: a comparison of usual and extended care				
Dec-15	Buis LR, et al. ³⁴	Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy	<i>Journal of medical Internet research</i>	Satisfied: 67.1% reported very high satisfaction Effective: txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise Efficient: Low participant costs	Text messaging	Michigan and Cincinnati only (geographically limited), strong sample (n=159)
2013	Houser SH, et al. ³⁵	Telephone follow-up in primary care: can interactive voice response calls work	<i>Studies in health technology and informatics</i>	Satisfied: Strong satisfaction reported for the interactive voice response system, IVRS Effective: Patients felt informed	Telephone	Small sample of those who received the call IVRS, small sample size (n=19)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2013	Kairy D, et al. ³⁶	The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty	<i>International journal of environmental research and public health</i>	Satisfied: Feeling an ongoing sense of support Effective: Tailored challenging programs using telerehabilitation Efficient: Improved access to services with reduced need for transportation, easy to use	Videoconferencing	Convenience sample, single case, small sample size (n=6)
2013	Bishop TF, et al. ³⁷	Electronic communication improves access, but barriers to its widespread adoption remain	<i>Health Affairs</i>	Satisfied: Easier access to and better communication with provider Effective: Patients with repeat issues of a condition are able to reset the treatment for the most recent episode Efficient: It takes about one minute per email, and it improves the efficiency of an office visit	Email and videoconferencing	New York City only, strong resistance to change cited (geographically limited), strong sample (n=630)
2013	Pietta JD, et al. ³⁸	Spanish-speaking patients' engagement in interactive voice response (IVR) support calls for chronic disease self-management: data from three countries	<i>Journal of telemedicine and telecare</i>	Satisfied: 88% patients reported "very satisfied", 11% "mostly satisfied" Effective: 100% patients felt the interactive voice response: IVR were helpful, 77% reported improved diet, 80% reported improved symptom monitoring,	Telephone	73% women, average 6.1 years of education (age and education bias), strong sample (n=268)

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				80% reported improved medication adherence		
2013	Gund A, et al. ³⁹	A randomized controlled study about the use of eHealth in the home health care of premature infants	<i>BMC medical informatics and decision making</i>	Satisfied: parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit Effective: Same or better outcomes because the parents did not have to bring infants in Efficient: Nurses took less than 10 minutes of work time daily to answer questions	Videoconferencing	Randomization used. Semi-structured interviews were only used for 16 families, small samples (n=13, 12, 9)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2013	ter Huurne ED, et al. ⁴⁰	Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study	<i>Journal of medical internet research</i>	Satisfied: High satisfaction Effective: Significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only Efficient: task completion rate was 80% for younger group and 64.6% for older group	Web-based	Not all participants reported the same diagnoses, strong pre-post design, strong sample (n=89)
2012	Chun, YJ & Patterson PE. ⁴¹	A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system	<i>Work</i>	Satisfied: on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system	Web-based	Small sample size (n=16)
2012	Lee ACW, et al. ⁴²	The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for	<i>Journal of Physical Therapy Education</i>	Satisfied: reported as high and very high Effective: Increases access where proximity is an issue Efficient: Links multiple providers together for teleconsultation	Videoconferencing	Limited scope for conclusions, patients in Mexico, providers in the U.S. (cultural bias), small sample (n=3)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		telehealth implementation				
2012	Saifu HN, et al. ⁴³	Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics	<i>The American journal of managed care</i>	Satisfied: 95% reported highest level of satisfaction Effective: 95% reported a preference for telemedicine versus in-person visit Efficient: reported a significant reduction in health visit-related time, mostly due to decreased travel	Videoconferencing	Veterans in Los Angeles CA only, convenience sample (geographically limited), strong sample (n=43)
2012	Lua PL, & Neni WS. ⁴⁴	Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia	<i>Telemedicine and e-Health</i>	Satisfied: 74% reported very or quite useful Effective: Excellent modality for education, drug-taking reminder, and clinic appointment reminder	Text messaging	Good mix of genders, homo-ethnic sample: 92.2% Malay (racial bias), median age 25 (age and technology bias – younger may already be more receptive to technology), good size sample (n=51)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2012	Finkelstein SM, et al. ⁴⁵	Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients	<i>Journal of telemedicine and telecare</i>	Satisfied: Ninety percent of the subjects were satisfied with the home health telehealth service Effective: Frequency of communication increased	Remote monitoring	Limited population
2011	Gibson KL, et al. ⁴⁶	Conversations on telemental health: listening to remote and rural First Nations communities	<i>Rural and Remote Health</i>	Satisfied: 47% positive response, 21% neutral, 32% negative Effective: Increased comfort in the therapeutic situation, increased usefulness Efficient: Increased access to services	Videoconferencing	First-nations communities only (limited population), strong sample (n=59)
2010	Doorenbos AZ, et al. ⁴⁷	Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities	<i>Clinical journal of oncology nursing</i>	Satisfied: Participants reported high levels of satisfaction with support groups via videoconference Effective: Results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors	Voice teleconference for group meetings	All participants were women (gender bias), rural care only, participants were members of American Indian or Alaskan Native (Limited population), strong sample size (n=900)

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Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2010	Breen P, et al. ⁴⁸	Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part II: the referring clinician and patient perspective	<i>BMC medical informatics and decision making</i>	Satisfied: Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management Effective: Telephysiology and control groups were equally as anxious about their procedure, telephysiology can improve access to CN services and expert opinion Efficient: Reduced travel burden and need for overnight journeys	Teleneurophysiology which included an EEG	Remote-rural population of Northern Ireland, small sample of physicians (n=9 physicians, 116 patients)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2010	Everett J & Kerr D. ⁴⁹	Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study	<i>Practical Diabetes International</i>	Satisfied: Patients reported more understanding, insight, and control by viewing data and easy access to health professional Effective: Intervention group demonstrated improved diabetes control Efficient: Health professional time was less than 10 minutes each day to review data and was incorporated into current workload	Telemonitoring and text messaging	Each user's home was visited to set up and demonstrate the system (good control for validity), small sample (n=16)
2010	Gardner-Bonneau D. ⁵⁰	Remote Patient Monitoring: A Human Factors Assessment	<i>Human Factors Horizons</i>	Satisfied: The intervention device was intuitive to use Effective: Telehealth group showed clinical improvements Efficient: Economic analysis showed savings in the COPD telemonitoring group, software issues caused many interventions by medical staff which consumed time	Remote monitoring	Medical literacy became an issue when the device asked patients if their readings were normal, small sample size (n=27 control, n=19 intervention)

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Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2010	Shein RM, et al. ⁵¹	Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating	<i>Assistive Technology</i>	Satisfied: Higher satisfaction with telerehabilitation Efficient: Great time savings in travel	Videoconferencing	89.6% Caucasian, average age was 55, (racial and age bias), good sample (n=32)

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172 Synthesis of Results

173 We analyzed the way 44 articles reported patient satisfaction.⁸⁻⁵¹ Twenty-four^{8,9,11,13,15-18,21-25,27-29,32,33,35,38,40,44,45,47} studies reported patient views on effectiveness, six^{10,12,14,30,41,51} studies reported patient satisfaction and fourteen^{19,20,26,31,34,36,37,39,42,43,46,48,49,50} studies reported both. The third column lists comments and details that could point to selection bias. Potential risk of bias among papers included: no randomization,¹² small sample size,^{11,13,18,21,23,25,28,33,35,36,41,48,50} limited population,^{15,20,27,29,31,45-47} gender bias,^{19,20,23,38,47} technology bias,^{18,23,44,50} selection bias,^{24,32,38} geographically limited,^{8,9,12,14,16,17,34,37,43} age bias,^{20,29,30,38,44,51} education bias,^{30,38} and racial bias.^{44,51}

181 Additional Analysis

182 Table two outlines the frequency with which different factors were raised among the included paper. Through a narrative analysis we identified commonalities among the various studies (19 factors) and compiled them into an affinity matrix to show frequency of occurrence. The matrix is sorted by frequency of occurrence.

186 **Table 2: Affinity matrix**

Factor	Article reference number	Frequency
Improved outcomes	8,9,11,13,15-17,18,20-26,31-33,38-41,47,50	24
Preferred modality	8,9,11,14,15,19,22,26,34,43,44,46	12
Ease of use	18,19,23,26,28,36-38,46,49,50	11
low cost, or cost savings	10,14,16,20,21,23,26,34,50	9
Improved communication	24,27,31,36,37,39,42,45,49	9
Travel time	10,12,20,30,36,43,48,51	8
Improved self-management	13,21,23,28,31,32,48	7
Quality	16,19,29,32,40	5
Increased access	19,42,46,48	4
Increased self-awareness	31,34,35,38	4
Decreased wait times	16,43,48,49	4
Fewer miles driven	10,14,20,51	4
Decreased in-person visits	12,39,43	3
Improved self-efficacy	13,23,31	3

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Good modality for education	15,34,44	3
Low time to manage	37,39,49	3
Improved medication adherence	13,38,44	3
Decreased readmissions	9,21	2
Fewer missed appointments	44	1
		119

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188 We acknowledge that frequency of occurrence does not equate to importance, but it has

189 been used in other literature reviews as simply an issue of probability.⁵²⁻⁵⁴ Five factors were190 mentioned in the literature 65/119 occurrences (55%): *improved outcomes*,^{8,9,11,13,15-17,18,20-26,31-}191 ^{33,38-41,47,50} *preferred modality*,^{8,9,11,14,15,19,22,26,34,43,44,46} *ease of use*,^{18,19,23,26,28,36-38,46,49,50} *low cost*192 or *cost savings*,^{10,14,16,20,21,23,26,34,50} and *improved communication*.^{24,27,31,36,37,39,42,45,49}193 **Discussion**194 **Summary of Evidence**

195 Telehealth has the potential to extend the boundaries of providers' practices by

196 overcoming the barrier of proximity. Along with the introduction of a new modality of care

197 comes change, and the literature mentioned various reactions to this change. One study identified

198 heavy resistance to change,^{29,37} while others mentioned an embrace of the change.^{29,48} Older

199 patients, in general, do not embrace change, but recent studies have identified a generational

200 acceptance of technology and mHealth in general.⁵⁵

201 Our findings from this systematic review and narrative analysis identify some issues that

202 are salient in the literature. To help overcome provider resistance to change to telehealth, it

203 should be noted that over the last seven years, 20% of the factors of effectiveness in the literature

204 were improved outcomes. Providers and patients should embrace telehealth modalities because

205 of its ease of use,^{18,19,23,26,28,36-38,46,49,50} its tendency to improve outcomes^{8,9,11,13,15-17,18,20-26,31-33,38-}206 ^{41,47,50} and communication,^{24,27,31,36,37,39,42,45,49} and its low cost.^{10,14,16,20,21,23,26,34,50} It can decrease

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3 207 travel time^{10,12,20,30,36,43,48,51} and increase communication with providers. Telehealth can provide a
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5 208 high quality service, increase access to care,^{19,42,46,48} increase self-awareness,^{31,34,35,38} and
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8 209 itempowers patients tomanage their chronic conditions.^{13,21,23,28,31,32,48} Healthcare organizations
9
10 210 should embrace telehealth because it decreases missed appointments,⁴⁴ it is a good modality for
11
12 211 education,^{15,34,44} it decreases wait times,^{16,43,48,49} decreases readmissions,^{9,21} and improves
13
14 212 medication adherence.^{13,38,44} But most importantly, policy makers need to help legislation catch
15
16 213 up with the technology by enabling additional means of reimbursement for telehealth because the
17
18 214 modality improves outcomes,^{8,9,11,13,15-17,18,20-26,31-33,38-41,47,50} which improves public health.
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23 215 Comparison

24 216 The results of our review and narrative analysis are consistent with other reviews. Health
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26 217 outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple
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28 218 studies,⁵⁶ Improvements have been identified for both physical and behavioral conditions. The
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30 219 review by de Jong et al., did not identify a significant decrease in utilization.⁵⁶ This review also
31
32 220 focused on interventions that used asynchronous communication, like email and text messages,
33
34 221 with an older population. Our study included both asynchronous and synchronous interventions
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36 222 with all ages.
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40 223 We were able to locate a study from 2011 that also evaluated telehealth and patient
41
42 224 satisfaction.⁵⁷ The researchers used secondary data analysis as the basis for their study. Their
43
44 225 study focused on patient satisfaction and home telehealth in US Veterans. Similar to the de Jong
45
46 226 review, this study focused on an older population ranging from 55-87, while our analysis
47
48 227 included younger age groups. Its focus on US Veterans while ours included this group as only
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50 228 part of our population. Our approach can equate to a greater external validity to our analysis. The
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52 229 Young et al. review found that its participants were extremely satisfied with the care
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54 230 coordination/home telehealth (CCHT) program. The US Veterans in this review embraced the
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3 231 new modality. The researchers found a decrease in utilization associated with the telehealth
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5 232 modality.

8 233 **Limitations**

10 234 We identified several limitations in the conduct of our literature review and narrative
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12 235 analysis. Selection bias is possible within this study, however our group-consensus
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14 236 methods will have mitigated against this risk. Publication bias is another risk, particularly as we
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16 237 did not extend our search to the grey literature. Limiting our search to only two databases could
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18 238 easily have omitted valid articles for our review. We controlled for inter-rater reliability through
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20 239 the initial focus study of the topic followed by several consensus meetings held along the
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22 240 iterative process. By continuing to review our findings, we follow the example of other reviews
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24 241 and narrative analyses.⁵²⁻⁵⁵

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29 242 The final limitation that we identified was the young age of the telehealth modality of
30
31 243 care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young.
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33 244 Because it is technologically based, we chose to only look at the last five years, which could also
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35 245 limit our findings, but the rapid advancement of a technologically-based modality drives a more
36
37 246 recent sample to make current observations and conclusions.

41 247 **Conclusions**

42 248 Overall, it was found that patient satisfaction can be associated with the modality of
43
44 249 telehealth, but factors of effectiveness and efficiency are mixed. We found that patients'
45
46 250 expectations were met when providers delivered healthcare via videoconference or any other
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48 251 telehealth method. Telehealth is a feasible option for providers who want to expand their
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50 252 practices to remote areas without having to relocate or expand their footprint of their practice. As
51
52 253 telehealth continues to be developed, special care should be given to incorporate features that
53
54 254 enable acceptance and reimbursement of this modality.

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3 **255 Basic definitions**
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6 **256** *Patient satisfaction*: The U.S. Center for Medicare and Medicaid Services defines this term as
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8 **257** the patient's perspective of care which can be objective and meaningful to create comparisons of
9
10 **258** hospitals and other healthcare organizations.⁵⁸

11
12 **259** *Effective*: successful or achieving the results that you want.⁵⁹ Usually associated with outcomes.

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14 **260** *Efficient*: performing or functioning in the best possible manner with the least waste of time and
15
16 **261** effort; having and using requisite knowledge, skill, and industry.⁶⁰
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20 **262 Data sharing statement**
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22 **263** All data are freely available
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24 **264 List of abbreviations**
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26
27 **265** AIM: Advice and interactive messaging system
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29 **266** BAN: Body area network
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31 **267** CCHT: Care coordination/home telehealth
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34 **268** CINAHL: Cumulative index of nursing and allied health literature
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36 **269** CVT: Clinical Video Teleconferencing
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39 **270** EBSCO Host: Elton B Stephens Company
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41 **271** HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems
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43 **272** HEDIS: Healthcare Effectiveness Data and Information Set
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46 **273** IVRS: Interactive voice response system
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48 **274** MEDLINE: U.S. National Library of Medicine bibliographic database
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50 **275** MeSH: Medical subject headings from the U.S. Library of Medicine
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53 **276** PPACA: Patient Protection and Affordable Care Act
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55 **277** WHO: World Health Organization
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5
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7
8 280 research.
9

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11

12 282 No humans or animals were involved in this study; therefore this study is categorized as IRB
13
14 283 Exempt in 45CFR46.
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17 284 **Consent for publication:** Not applicable
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19
20 285 **Availability of data and materials:** Not applicable
21

22 286 All data and materials used in the creation of this manuscript are included in the appendices
23

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25

26
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28

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30

31 290 The contributions of the six-member team meet the requirements for authorship. CK directed the
32
33 291 initial research, served as lead author, mediated discussions about the merit of abstracts/articles,
34
35 292 integrated the input from all team members, and helped refine the figure and tables to provide
36
37 293 continuity and flow. NK contributed the initial draft of the introduction, and integrated her
38
39 294 viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR
40
41 295 contributed the initial draft of the abstract, and she integrated her viewpoints into the methods,
42
43 296 discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the
44
45 297 initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the
46
47 298 initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB
48
49 299 served as an expert in research in U.S. Veterans due to his research in this area, and he
50
51 300 contributed meaningful contribution to the formation of analysis and conclusion.
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5
6 302 **FIGURE LEGEND**

7 303 **Figure 1: Literature Search process with inclusion and exclusion criteria**
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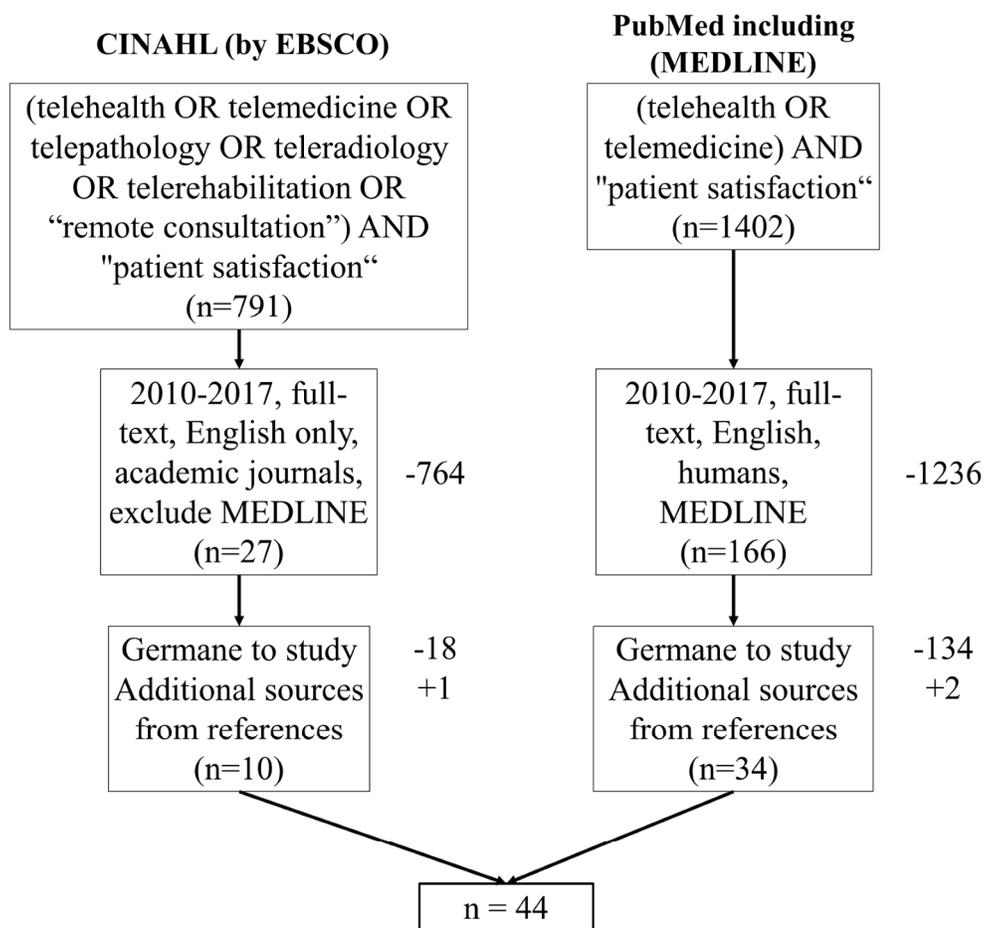
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Article selection process with inclusion and exclusion criteria

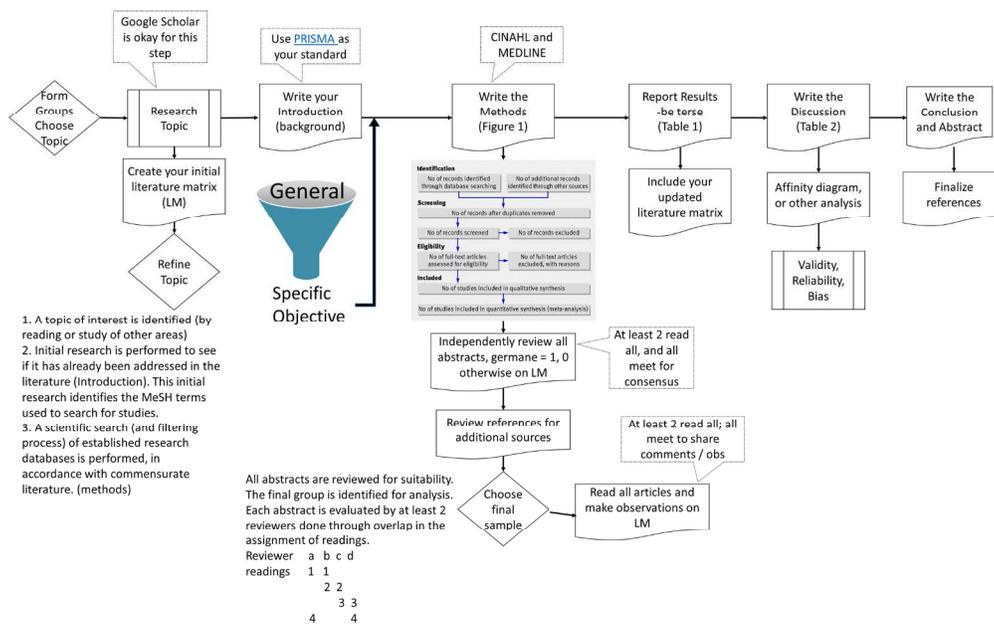
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3 1 Supplemental data
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6 2 Search terms
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10 3 Search strings for the two research databases differed because of the differences in the
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12 4 indexing methods used by each database. PubMed indexes the following under the heading of
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14 5 telemedicine: telerehabilitation, teleradiology, telepathology, and remote consultation. CINAHL
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16 6 does not automatically index these terms together so they were searched for by name. The initial
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18 7 search in PubMed was (telemedicine OR telehealth) AND "Patient Satisfaction."
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PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2 for each meta-analysis).	



PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Page 2 of 2

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